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The Excess Negative Over Positive Mesons Produced by High Energy Photons, by K. A. Brueckner and M. L. Goldberger is AECU-651, not AECU-657 as listed in NSA 4-707, Vol. 4, No. 3, Feb. 15, 1950.

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GENERAL

1321 How Atomic Power May Affect Electric Power Systems. Ward. F. Davidson. Public Utilities Fortnightly 45, 26-39(1950) Jan. 5.

The economic and technical problems that are involved in the matter of applying atomic power to electric power systems are completely described. The author discusses the difference between chemical reactions and fission and the tremendous amount of heat released in the latter process. This presents countless engineering problems in designing power plants, heat exchangers, etc., to run the turbines for the production of electricity. The pile is described and the possibility of generating steam in the reactor by using less coolant water is mentioned. Other problems discussed are, nuclear fuels, general reactor design, means for replenishing the charge, control, shielding, and comparative costs of coal burning and atomic fuel power plants.

BIOLOGY AND MEDICINE

1322 A Study of the Effect of Thiazine, Oxazine, and Phenazine Dyes on Normal and Heparinized Rabbit Plasma. Thomas J. Haley and Frances Stolarsky. UCLA-48, Nov. 14, 1949. 15p.

A study using a modified Astrup method (Acta Pharmacol. Toxicol. 3, 165(1947)) has been made of the effect of seven dyes of the phenazine, oxazine, and thiazine series on the in vitro coagulation times of normal and heparinized rabbit plasma. Toluidine Blue, Azure A, Neutral Violet, and Neutral Red effectively counteract the anticoagulant action of heparin; but the amount of each dye required for this anti-heparin effect is critical. At concentrations below the critical level the dyes had little or no effect upon the coagulation system studied. At concentrations above the critical level all the dyes produced a progressively increased incoagulability of the system. This anticoagulant effect of the dyes is related to concentration and the action is on some substance other than heparin. 10 references. (auth)

1323 Approximate Theoretical Solution of a Problem of Scattering of Soft X-rays (λ Between 0.25 and 0.56 A) and Its Consequences in Medical Radiology. R. H. de Waard. Brit. J. Radiology 21, 454-63(1948) Sept.

Approximate solutions of the problem of the scattering of soft x-rays are applied to the discussion of superficial x-ray therapy in skin diseases, and to the evaluation of densities and contrasts in radiographs.

1324 The Calculation of the Energy Deposition in Soft Tissue by Fast Neutrons Emerging from a Non-Capturing Medium. M. B. Biram. Atomic Energy Research Establishment Report No. AERE-T/R-443, Nov. 21, 1949. 10p.

The dose in rep is calculated at interior points of a half space of soft tissue, for the case of monochromatic fast neutrons entering the tissue from a noncapturing isotropically scattering medium. The variation of mean free path with energy is neglected, and, with this approximation, the biological effects can be shown to be proportional to the energy flux. This is then expressed as a function of depth of tissue, using the Spherical Harmonics P_7 approximation (MDDC-236). (auth)

BIOLOGY AND MEDICINE

1325 The Calculation of the Energy Deposition in Soft Tissue by Thermal Neutrons. J. H. Tait. Atomic Energy Research Establishment Report No. AERE-T/R-416, Oct. 1949. 20p.

The amount of energy is calculated, which would have to be deposited by γ rays in a semi-infinite medium containing tissue, to obtain the same biological effect as a unit flux of neutrons entering normally to the free surface. Two alternative values for the tolerance flux of thermal neutrons are obtained. One is obtained by comparing the dose received in the epidermis, from a given neutron flux over an 8-hr period, with the maximum permissible dose from β rays, and the dose received in the connecting tissue with the maximum permissible dose from γ rays. This gives a tolerance flux of 1800 n/cm²/sec. If, however, it is specified that the maximum dose in the tissue is not to exceed the maximum permissible dose from γ rays in an 8-hr period, the tolerance flux is 1200 n/cm²/sec. (auth)

1326 Depth Dose of Electrons from the Betatron. L. S. Skaggs. Radiology 53, 868-73(1949) Dec.

By means of a water phantom the author measured the depth dosage due to a collimated beam of electrons from a betatron. Depth dose curves, normalized to peak ionization at 100%, are given for electron energies of 16.4, 14.3, and 12.2 Mev. They show a rise of ionization from the surface of the phantom to a point a few cm deep, the effect becoming less pronounced at higher energies. A short distance beyond the point of maximum ionization, the dose falls rapidly to a small value, and finally reaches a value of about 1.2% due to x-ray background. The extrapolated ranges obtained from the experimental depth dose curves agree to within 3% with the theoretical ranges. Finally, isodose curves are given for 16.4-Mev electrons.

1327 Effects of X-rays and Nitrogen Mustard on Lymphatic Nodule of the Rabbit. P. P. H. De Bruyn and R. C. Robertson. Proc. Soc. Exptl. Biol. Med. 72, 717-18(1949) Dec.

The histological effects on the lymphatic nodules of the rabbit of x-rays and the nitrogen mustard methyl bis (B-chloroethyl) amine hydrochloride are presented; the LD_{50} (50% lethal) dose of these is 800 r for the x-rays and 2 mg/kg for the nitrogen mustard; it was found that there is no quantitative histological difference in the response of the lymphatic nodules in rabbits to the LD_{50} doses of these two agents. The difference is minor in the mesenteric lymph node, where there is a slightly earlier regeneration after nitrogen mustard; the difference is greater in the appendix, since the histologic changes after nitrogen mustard administration at the LD_{50} level are comparable to those changes observed after half of the LD_{50} dose of x-rays.

1328 The Lateral Distribution of Ions Across the Track of an Ionizing Particle. Part I. The Present Picture and Its Implications. John Read. Brit. J. Radiology 22, 366-74(1949) July.

If Lea's (Brit. J. Radiology (Supplement 1), 59(1947)) picture of the lateral distributions of positive and negative ions across the track of an ionizing particle is correct, then the separation of charge must lead to a radical electric field. Expressions are deduced for this field, the cor-

responding potential differences, and the energy per ion pair stored in the field. Numerical values are obtained for an ion density of 1,000 ions per micron in water, hexane, and a chromosome thread. The field is of the order of 10^5 v/cm at relatively large distances from the axis of the track. An approximate expression is derived for the distribution of the positive and negative ions when in thermal equilibrium. Small ion densities can be in equilibrium with quite large separation of charge, but in the case of ion densities of 1,000 ions per micron Lea's distributions are far from equilibrium, and the electrons would return to the positive core unless captured. If, when an ionizing particle passes radially across a chromosome, this separation of charge occurs, and the electrons become attached to the fabric of the chromosome, then tensions of the order 10^5 dynes/cm^2 would be produced normal to circles of radius comparable with that of the chromosome. A tension wave would travel in both directions away from the point of intersection of track and chromosome. If the chromosome has weak points, e.g., between genes, breaks might be produced here, and the minute deletions might be due to the two tension waves each producing a break. Reference is made to the work of Jaffé (Ann. Phys. 42, 303(1913)).

1329 Limb Regeneration in Triturus Viridescens as Affected by Lethal Doses of Radioactive Phosphorus. J. N. Dent. Anat. Record 105, 325-35(1949) Oct.

Adult specimens of Triturus viridescens were injected intraperitoneally with solutions containing P^{32} in doses which produced radiation intensities of 33, 66, or 166 μc/g of body weight at the time of injection. The right forelimbs were excised in the carpal region approximately one week following injection and were analyzed; all three dosages were considered to be lethal since all the experimental animals died. The histological examination of limb stumps removed 23 days following the original excision revealed that typical blastemata were developing on limb stumps of control animals; limb stumps from experimental animals which had received 66 or 33 μc/g gave some indication of beginning regeneration. The blastema region was characterized by: an atypical epithelium which either contained many enlarged and lobate cells or was made up entirely of flattened cells of the squamousal type; a relative scarcity of mitotic figures; and, a relatively low number of cells per unit volume of tissue. Epithelium covering limb stumps removed from animals which had been treated with 166 μc/g of body weight was made up, for the most part, of enlarged and distorted cells; no indication of blastema formation was seen in the sub-epithelial region; mitotic figures were extremely rare.

1330 Some Papers on the Effects of Radiations on Bacteria and Moulds. Atomic Energy Research Establishment Report No. AERE-Inf/Bib-51, Oct. 14, 1949. 7p.

This bibliography lists 69 references covering the period 1930 to April 1949.

1331 Synergistic Action of Estrogenic Hormone and X-rays in Inducing Thymic Lymphosarcoma of Mice. Arthur Kirschbaum, Joyce R. Shapiro, and Harry W. Mixer. Proc. Soc. Exptl. Biol. Med. 72, 632-4 (1949) Dec.

Two groups of mice, one of the Bagg albino and the other of the CBA strain, each received a single dose of 200 r of x-rays at 1-70 days of age. Two groups from the same stocks received 14 weekly injections of 5 μg of estradiol dipropionate in peanut oil beginning at 42 days of age; in a third treatment series 2 groups of mice received 200 r at 42 days followed by the 14 weekly injections. Methylcholanthrene skin applications and doses of 200 r of x-rays were given to mice of the dba stock. It was found that synergistic lymphomogenic effects were obtained when the estrogenic hormone and the x-rays were administered simultaneously to the mice. Thymic lymphoid tissue appeared to be more sensitive than other lymphoid tissue; this was also true when x-rays and methylcholanthrene acted synergistically in the dba stock.

1332 Target-Theoretical Interpretation of the Relation between the Steepness of the Dosage-Effect Curve and the Ionization Density. Kurt von Sanden. Z. Naturforsch. 4b, 257-62(1949) Oct.-Nov. (in German).

A statistical theory is developed which describes the effect of a given dosage of ionizing radiation on a set of biological objects distributed at random in the space filled by the radiation. It is assumed that an elementary target area must suffer simultaneous multiple hits to be affected by the radiation. The ionization density enters from the beginning into the formulation of the statistical problem, with the result that the steepness of the dosage-effect curve decreases with increasing ionization density.

1333 Particle Size Determination in Radioactive Aerosols by Radio-Autograph. J. A. Leary and Francis J. Fitzgibbon. AECD-2791, June 7, 1949, decl. Jan. 18, 1950. 17p.

A radioautographic technique has been used to study particles size distribution in an aerosol of an α-emitting compound. By counting the number of tracks in the emulsion for a given exposure time, the size of each emitting particle was calculated from the following derived formula: $d = (Kc/t)^{1/3}$; where c = number of tracks in emulsion from particle of diameter "d" microns, t = autograph exposure time, and K = constant. The distributions observed on a series of filter papers for determination of removal efficiency for particles in the feed to and discharge from an air decontamination plant are shown. Particles as small as 0.2 μ have been accurately determined in aerosols containing as little as 0.8 $\mu\mu$g active material per liter of air.

1334 Amyloid Degeneration of the Human Brain Following X-ray Therapy. K. Lowenberg-Scharenberg and R. C. Bassett. J. Neuropathol. Exptl. Neurol. 9, 93-102(1950) Jan.

Two cases of the degeneration of the normal human brain following an overdose of x-rays are presented. The first patient received a total dose of 6,000 r delivered to the left temple region in 10 treatments within 12 days, 600 r being applied daily at 150 kv without filtration; the size of the field was 57 × 41 mm. Twenty-two months later she received a second course of radiation therapy, consisting of a total dose of 3,600 r delivered at 180 kv in 24 sessions of 150 r/treatment; field size and filtration are not reported. Approximately 71 months after the first course the patient

became nervous, complained of general malaise and headaches and experienced speech difficulties and impaired vision. Upon operation, the skull and dura showed no significant changes, but in a region including the area of Broca, the brain tissue was purple-gray; upon excision an uneventful recovery was made. About 40 months following irradiation of the right parietal region with about 3,500 r at 130 kv without a filter and 110 kv with a filter, the second patient suffered convulsive seizures and upon operation a similar brain lesion was discovered. The dominant histological finding in the two cases was the formation of the amorphous substance in the areas of the brain exposed to excessive irradiation. It is concluded that the degeneration noted in these areas is similar to that observed in the spleen and is termed "amyloid" in nature.

1335 Lesions of the Eye from Radiant Energy. David G. Cogan. J. Am. Med. Assoc. 142, 145-51(1950) Jan. 21.

This report discusses the sources and types of radiation, the transmission and absorption of radiant energy in the ocular media and the clinical characteristics of the lesions of the eye caused by radiant energy. Radiant energy is divided into two broad types: the electromagnetic type represented as waves of energy, the range of which covers the spectrum and includes roentgen rays, grenz rays, radiowaves and light waves; the second type consists of corpuscular radiation consisting of subatomic particles, such as electrons and neutrons. With the potentials commonly employed in roentgen treatment (100-200 kv), 90% of the energy incident on the anterior surface of the cornea may be expected to reach the retina; keratitis of the cornea may occur from irradiation with 4,000-6,000 r in several weeks' time, and cataracts are known to be caused by doses of 500-800 r at 100-200 kv; roentgen rays are tentatively classed as inactive on the retina. Radiation burns, their characteristics and treatment are also discussed.

1336 Protection Against X-ray and Beta Radiation with New Lead Glass Fabric. Vincent W. Archer, George Cooper, Jr., H. D. Hebel, J. G. Kroll, and D. A. Cunningham. Hosp. Management 69, 104, 106 (1950) Jan.

A garment of spun lead glass fabric has been developed which, it is claimed, affords ample protection to all vulnerable parts of the body from x-radiation. The same fabric is highly resistant to β radiation of atomic fission products.

1337 Radiation-Exposure Survey of X-ray and Isotope Personnel. Charles K. Spalding, Egilda DeAmicis, and Russell F. Cowing. Nucleonics 5, 63-6(1949) Dec.

Analysis of a total of 7,678 films worn by personnel in these two fields shows clearly that the x-ray worker received considerably more radiation exposure than the isotope worker.

1338 The Shoe-Fitting Fluorscope as a Radiation Hazard. Leon Lewis and Paul E. Caplan. Calif. Med. 72, 26-30(1950) Jan.

A series of tests on shoe-fitting fluoroscopes was run to determine the amounts of radiation to which patrons and salesmen are constantly exposed. Estimations of weekly exposure were made by placing film badges strategically on the personnel in close contact with the machines; direct measurements were made within the shoe-fitting chamber on 40 machines through the use of a dosimeter r-meter, the exposures being timed for 30 seconds. The beam intensities of the machines tested were 10-109 r/min, in most cases far in excess of standards proposed for safe use of the apparatus. It is stated that the principal potential danger from the machines is interference with bone growth in children as a result of careless use or uncontrolled dosages; some possibility also exists of excessive exposure of shoe salesmen in exceptional circumstances.

BIOLOGY AND MEDICINE

1339 Attempts to Prevent and Counteract Effects of Ionizing Radiations by Chemical and Pharmacological Means. W. A. Selle. NEPA-1127, Sept. 15, 1949. 30p.

The purpose of this report is to summarize available information concerning attempts to prevent or reduce radiation injury by pharmacological means. The pathogenesis of lethal and sublethal radiation exposures, and the theories and therapies of radiation sickness are discussed. The effects of the following agents on human radiation sickness are summarized in tabular form: desoxycorticosterone acetate and pyridoxine; antihistaminics, vitamins, and miscellaneous drugs; antihistaminics, transfusions, and antihemorrhagic substances; ascorbic acid, riboflavin, thiamin, nicotanamide, and nucleic acid compounds; rutin and related drugs; folic acid; adrenal cortex, desoxycorticosterone, and related drugs; estrogens and other sex hormones; cysteine, cystine, and glutathione; and penicillin and blood transfusions. 72 references.

1340 The Hemorrhagic Syndrome of Acute Ionizing Radiation Illness Produced in Goats and Swine by Exposure to the Atomic Bomb at Bikini, 1946. E. P. Cronkite. Blood 5, 32-45(1950) Jan.

This preliminary paper based on field tests at Bikini in July 1946 is concerned with a description of the hemorrhagic syndrome encountered in goats and swine following irradiation by an atomic bomb. Of 176 goats exposed to the aerial atomic explosion, 31 developed detectable effects of radiation; 14 of these showed purpura, while four exhibited a prolonged clotting time. A total of 20 swine were exposed to the underwater atomic explosion; all animals were below decks and it is concluded that most of the irradiation to which they were subjected was γ radiation at the time of the explosion or γ emission from fission products showered upon the ships after the explosion; the greater part of this irradiation was received within two days. Red blood cell counts, prothrombin and whole blood clotting times, hemoglobin determinations, hematocrit readings, white and differential blood cell counts and clot retraction times were taken on the swine and goats before and at intervals after exposure. The hemorrhagic syndrome is considered to be predominantly a result of a combination of "increased vascular fragility" and thrombopenia. Infrequently, a blood coagulation defect characterized by a prolonged clotting time due to a circulating antibody with heparin-like properties may occur, but only in fatally irradiated animals. Evidence is presented suggesting that serum fibrinolysins may have been activated by the irradiation. It is concluded that a hemorrhagic syndrome can develop in irradiated dogs,

goats, swine, rats, chickens, and guinea pigs without the appearance of a prolonged clotting time and without a detectible "heparinemia." The most common phenomena observed in the syndrome, it is stated, appear to be an increased vascular fragility, thromopenia, and ulcerations. 35 references.

1341 Radiophotographic Method of Quantitative Determination of Natural and Artificial Radioactive Elements in Plants. A. A. Drobkov. Doklady Akad. Nauk S.S.S.R. 68, 177-80(1949)(in Russian). (See also NSA 1-1790.)

By spreading plant material upon a photographic plate in darkness, pictures showing accumulations of radioactive substances in various organs can be obtained. Experiments with natural and artificially-obtained radioactive substances are mentioned (four photographs), as are also findings on the physiological need for Ra, U, and Th in plant life and on the constant presence of these elements in all soils, waters, and living organisms.

1342 Carcinoma of the Breast: An Analysis of 626 Cases Referred for X-ray Therapy. Harvey W. Stone and Halvor Vermund. Bull. Univ. Minn. Hos. and Minn. Med. Found. 20, 376-97(1949) Mar.

The results of palliative or post-operative deep roentgen therapy on a series of 626 patients with carcinoma of the breast are presented. A total of 314 cases were operable and were treated by surgery followed by post-operative irradiation; 149 were treated by irradiation for inoperable tumors, and 142 were treated by irradiation for recurrences or distant metastases. The post-operative irradiation was as a rule started within 30 days after operation and consisted of delivering irradiation from a 140-220-kv source through 0.25-0.5 mm Cu and 1 mm Al filtration at 60-70 cm distance; the doses were 200-600 r and the total dosages (about 600-1,200 r/field) were variable according to the number of fields irradiated and the changes in technique incorporated over a period of years. Inoperable tumors were treated by irradiation of quadrants, each field being treated by the fractional dose method so that the total dose/field was 1,000-1,500 r, with 200-300 r as the maximum daily dose; metastatic cases were treated with a total of about 1,000 tissue r delivered from a 100-140-kv source. Of the operable cases, 47% survived five years; 4% of the inoperable tumors and 14% of the metastatic cases also survived five years. 33 references.

1343 The Distribution of Radioiodine in a Patient with Metastatic Adenocarcinoma of the Thyroid. Joseph E. Rall, F. Raymond Keating, Jr., Marschelle H. Power, and Warren A. Bennett. J. Clin. Endocrinol. 9, 1379-91(1949) Dec.

Clinical and necropsy data on a patient with adenocarcinoma, grade 4, of the thyroid gland, treated with 63 μc of radioiodine, I^{131}, are reported. The distribution of radioiodine in the various tissues and organs was determined and used as a basis for estimating the quantity of radiation received by various tissues. Except for the thyroid gland and one metastatic growth, the quantity of radiation appeared negligible; marked disparity was observed in the accumulation of iodine in the primary tumor and various metastatic growths. This could be correlated to some extent with differing degrees of histologic differentiation.

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1344 Experiences with Roentgen Treatment of Brain Tumors. Reinhold Lorenz. Zentr. Neurochirurgie 9, 209-15(1949)(in German).

The results of the irradiation with x-rays of 91 cases of brain tumors are presented. The radiations were delivered from a 180-kv source with a filtration of 1 mm Cu and 2 mm Thoraeus at a target distance of 40 cm. The head was irradiated in 5 to 6 fields; the initial daily dose was 50 r, but was rapidly increased to 250 r for a total field dose of about 3,000 r. A large number of the cases yielded satisfactorily to the irradiation treatment, but since the 5-year results are not as yet available, the author declines to draw conclusions.

1345 Indirect Ray Treatment of Vegetative Trophoneurotic Disturbances. K. Herbert Parnitzke. Zentr. Neurochirurgie 9, 215-26(1949)(in German).

The results of the x-ray treatment of the vegetative (autonomic) nervous system in 48 cases of trophoneurotic ulcera are presented; the axial sympathicus on both sides, the regional periarterial plexus at the vascular crossings and partly the foci themselves were irradiated after the development of the ulcera following nervous injuries and functional vascular diseases, causalgias and stump complaints. The radiations were delivered at 160 kv through a filtration of 0.5 mm Cu; 100-200 r were given at each sitting, until a total dose of 400-800 r was reached. Improvement was noted in 63% of the cases, and the results were further improved by the therapeutic combination of x-ray treatment and artificial fever therapy.

1346 Plesiotherapic Treatment (Chaoulterapy) of Some Deep Ocular Affections. Massimo Morano and Bruno Franchi. Ophthalmologica 118, 30-41(1949).

The results of the treatment of 55 patients with inflammatory ocular infections with plesioroentgentherapy are presented; of these, 25 had inflammatory uveal infections, 7 had chorio-retinitis, and 23 exhibited inflammatory corneal processes. Three techniques for irradiation were employed: for the inflammatory corneal processes radiations of about 100 r per sitting from a 55-kv source at a target distance of 1.5 cm with no filtration were delivered; doses of 160-165 r per session from a 55-kv source at a target distance of 3 cm with a 3 mm cellulose filtration were used in the cases of uveitis; and, doses of 190-195 r were given in the chorio-retinitis cases from a 55-kv source with a filtration of 3 mm of cellulose and a target distance of 5 cm. It is concluded that the techniques described produce favorable results in some cases of deep inflammatory ocular infections. 40 references.

1347 Radium in Treatment of Hemangioma. F. Ronchese. Arch. Dermatol. and Syphilol. 60, 717-21(1949) Nov.

Results in the treatment of infantile cavernous hemangioma by radiations are presented. Surface radium treatments were administered in a number of cases and consisted of applications of the usual tubes of 25-50 mg, having a container filtration of 0.5 mm of Ag and 1 mm of brass and placed at 1 cm distance from the skin for 3-4 hr; doses were delivered

at intervals of 6 to 8 weeks, and from 1 to 10 times, the hemangioma being surrounded by 1 mm of Pb foil during irradiation. The results were favorable, and upon re-examination of 28 of the patients for external appearance, scars, deformities and skeletal damage (by comparison of the treated area with the same area of the opposite side of the body) it was found that in no case were any cutaneous, bony, or articular sequelae demonstrated. The author concludes that irradiation still has its place in the treatment of selected cases of infantile cavernous hemangioma, notwithstanding criticism concerning its dangers; a happy medium between extensive radium therapy and the present trend of condemnation should be sought.

1348 Regional Enteritis: Roentgen Therapy. Walter C. Popp, J. Arnold Bargen, and Claude F. Dixon. Proc. Staff Meetings Mayo Clinic 25, 1-5(1950) Jan. 4.

The results of the treatment of 43 cases of regional enteristis by roentgen therapy are presented. The roentgen therapy consisted of irradiation of four areas covering the whole anterior aspect of the abdomen; the radiations were generally delivered at 130 kv with a filtration of 6 mm of Al; the output was 135 r measured in air. At least three courses of treatment were usually given at intervals of one month, and subsequent treatment was based on the recurrence of symptoms; frequently patients had several series of courses. Of the patients treated by this method, 20 became largely symptom-free and were able to return to their former occupations; 14 others were improved, seven were not helped, and two died. Additional therapeutic measures in these cases included a high-protein diet and periodic courses of sulfathalidine. The authors conclude that the active disease may be stayed or at least interrupted by this therapy, but such healing and subsequent cicatrization are likely to occur as to necessitate surgical intervention.

1349 Report on a Series of 129 Cases of Cancer of the Corpus Uteri. Gertrude Dearnley. J. Obstet. Gynaecol. Brit. Empire 56, 819-32(1949) Oct.

A detailed survey is presented on 129 cases of carcinoma of the corpus uteri treated at the Royal Free Hospital between 1926 and 1943; 54 of these cases were treated by surgery and 75 by radium therapy. The latter technique consisted of the insertion of two or more radium tubes, containing 50-70 mg radium, in tandem into the cavity of the uterus; in addition, in 14 cases two small cylinders containing approximately 12.5 mc of radon or 8 mg of radium each, were placed in the cornua. Vaginal applicators containing approximately 25 mg of radium each, were placed in the fornices by means of gauze packing. Several series of insertions were usually given, and the total dosages for the radium were 1,243-8,047 mg hr, and 700-6,571 mg hr for the radon. Surgery showed a 5-year cure rate of 72.2% and a 10-year cure rate of 61.5%, while the radium therapy yielded a 5-year cure rate of 45.3% and a 10-year cure rate of 35%.

1350 Roentgentherapy of Corneal Affections. A. Strazzi. Boll. Oculistica 28, 267-72(1949) May.

The results of the roentgentherapy of 770 cases of ocular affections are presented. The technique consisted of irradiation from a 170-180-kv source through a filtration of 0.52 Cu and 3 mm Al at a distance of 35 cm; 5 or 6 daily doses of 60-80 r were given. On the basis of the excellent results obtained, the author concludes that this form of therapy is advantageous with acute or chronic inflammatory corneal affections.

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1351 Surface and Emergent Doses in Radiotherapy. J. R. Clarkson and R. J. T. Herbert. Brit. J. Radiology 21, 494-500(1948) Oct.

The influence of the limited depth of an irradiated medium on the surface dose with back-scatter and on the exit dose is disucssed. It is suggested that (except near to the surface of entrance of the x-ray beam) the amount of forward-moving scattered radiation is equal to the backward-moving scattered radiation. This leads to the rule that the percentage dose at the surface of emergence of the beam is equal to 1/2 (percentage depth dose at that depth for the field size being irradiated plus depth dose for the primary beam only). This rule has been found to be satisfactorily consistent with measurements in a water-phantom and also on patients during treatment. Apart from the case of emergent dose, measurements on patients have not shown any large or systematic divergence from calculations made with the aid of normal isodose-curves.

1352 The Effects of Exposure of Rabbits and Rats to Inhalation of Uranium Dioxide Dust at 80 mg/m³ Concentration and 2 μ Mass Median Particle Size. Herbert B. Wilson and George Sylvester. AECU-670, nd. 22p.

The effect of an insoluble uranium dust, UO_2, on its retention in the lung and its resultant toxicity has been determined in rats and rabbits for a dust with a particle size of 2 μ at an air concentration of 80 mg/m³. This is the 4th of a series of similar studies that adds more evidence to indications already obtained that dust of larger particle size (2 μ) is retained to a smaller extent from inhaled air and creates a lesser toxicity problem than do dusts of smaller size (less than 1 μ). Uranium dioxide with a mass-median particle size of 2 μ at 80 mg/m³ concentration was not toxic to rats and only very slightly toxic to rabbits. This presents a contrasting picture with that found in the same animal species but exposed to a particle size smaller than 1 μ. Here toxicity in both species was amply evident. Evidence from (1) almost complete lack of change from normal weight response, (2) almost negligible changes in urinary protein, (3) no changes in urinary amino acid, (4) blood NPN, and (5) only slight evidence of renal injury in a minority of rats and rabbits exposed daily for a period covering 37 days aid confirmation to the above observation. Retention in the lung was decidedly less from the 2 μ particles in the present study than from the smaller sizes at the same level of exposure concentration. For the rabbit lung, this amounted to nearly 50 times less; the rat lung differences arising from particle size were not so striking but still amounted to approximately 8 times less. No distinction according to particle size arising from transport of the uranium from the lung was noted in either the femur or the kidney. Uranium content of these tissues was of a far lower order of magnitude than that found in the lung and did not vary appreciably with particle-size change. (auth)

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1353 Air Pollution and the Particle Size-Toxicity Problem. I. Herbert E. Stokinger. Nucleonics 5, 50-62(1949) Dec.

After a section devoted to the general problems of industrial air pollution, the author discusses specific types of pollution, such as the pollution caused by beryllium wastes and by the toxic materials used in the uranium industry. The effects of various toxic materials are described.

1354 The Histochemical Detection of Beryllium. F. A. Denz. Quart. J. Microscop. Sci. 90, 317-21(1949) Sept.

A histochemical test for beryllium in paraffin sections is described; a "green lake" that is formed with Be by the dyestuff Naphthochrome green B was found to be specific for Be under the stated conditions. The test works only with soluble compounds of Be; deposits of as little as 3 μg of Be can be detected and the distribution in the tissues of mice can be followed after the intravenous injection of 200 μg of Be. The applications and limitations of this method are discussed.

1355 The Oxidation of Carbon Monoxide to Carbon Dioxide by Animal Tissues as Shown by Experiments with C^{14}. I. The Oxidation of Carbon Monoxide by Isolated Tissues. II. Evidence for the Conversion of Carbon Monoxide to Carbon Dioxide by the Intact Animal. Robert T. Clark, Jr., J. Newell Stannard, and Wallace O. Fenn. UR-97, Oct. 27, 1949. 26p.

Various tissues of the frog were exposed to 80% CO and 20% O_2 for periods ranging from 5-10 hr. The rates of gas consumption in the CO-O_2 mixture and in air were measured in a respirometer. The radioactive isotope C^{14} was used in the CO-O_2 mixtures and the amount of CO burned to CO_2 was calculated from radioactivity measurements of the respired CO_2. The amount of CO burned was found to agree with the excess gas consumption in the respirometer, thereby showing that the excess gas consumption was due to the burning of CO to CO_2. The rate of CO oxidation by frog tissue was found to be highest for heart muscle, next for skeletal muscle, and negligible in nerve or skin; and the amount of CO burned to CO_2 but retained within the tissue was found to be a small fraction of the total CO burned. It appears that the burning is superimposed upon the resting metabolism of muscle tissue with perhaps slight inhibition of the latter. Sodium azide and hydroxylamine completely block the oxidation of CO measured by both respirometer and isotope techniques.

The ability of the turtle and the mouse to oxidize CO to CO_2 at low but measurable rates has been demonstrated by two methods: (a) gasometric measurement of the CO disappearing from a closed system and (b) collection of radioactive CO_2 from animals breathing mixtures containing small amounts of $C^{14}O$. This is the first demonstration of this process in the intact animal. If extrapolated to man, the data predict CO oxidation at a rate of about 20 ml/hr by a 70-kg man. 14 references. (auth)

1356 Absorption and Excretion of DL-Thyroxine Labelled with Radioactive Iodine. J. C. Clayton, Audrey A. Free, J. E. Page, G. F. Somers, and E. A. Woollett. Biochem. J. 45, No. 4, xx(1949).

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DL-Thyroxine labeled with I^{131} in the 3′ and 5′ positions was used in a study of the absorption of iodine from the digestive tract and the behavior of physiological doses by the intravenous and subcutaneous routes. The amounts of I^{131} found in the bile, urine, and feces, as thyroxine, diiodotyrosine, and iodide, were measured. The I^{131} found in the urine was present almost entirely as iodide, whereas that in the feces was present in both organic and inorganic forms. Experiments with cats showed that iodine in the bile was related to the blood concentrations; the I^{131} was present in the bile in approximately equal proportions in organic and inorganic forms. Appreciable amounts of I^{131} were secreted into the stomach, but very little activity was found in the thyroid glands.

1357 The Absorption of Sulfur Dioxide by Plants as Shown by the Use of Radioactive Sulfur. Maurice Fried. Soil Sci. Soc. Am. Proc. 1948 13, 135-8(1949).

The degree of utilization and incorporation of atmospheric sulfur dioxide (SO_2) by growing plants was determined through the use of S^{35} as a tracer in the SO_2. The details of the experiments and the techniques involved are described in detail. It was found that alfalfa plants can take in sulfur dioxide through the leaves and convert it into organic sulfur compounds; the atmospheric sulfur dioxide serves as a source of sulfur in the nutrition of the plant. Radioautographs taken after the plants were grown in a radioactive solution revealed higher concentrations of radioactivity in the younger tissues, and when low levels of S^{35} were administered, the amount of sulfur in the veins was definitely lower than the amount in the intravenous tissue.

1358 The Action of an Analogue of Ethanolamine (Diethanolamine) on the Formation of Liver Phospholipides. Camillo Artom, W. E. Cornatzer, and Marietta Crowder. J. Biol. Chem. 180, 495-503(1949) Sept.

Male albino rats of the Wistar and Sherman strains maintained on low protein diets were injected intraperitoneally with a solution of Na_2HPO containing 2-4 μc of P^{32} and 6 hr later were killed by decapitation. The administration of a single large dose of diethanolamine or ethanolamine stimulated lipid phosphorylation in the livers of the sacrificed rats, a result of increased choline and noncholine phospholipid formation. If the rats were fed diethanolamine along with the diet, the isotope content of the total phospholipids was lower than in the controls, due, it is concluded, to an inhibition of the formation of choline-containing phospholipids; total lipids increased. Presumptive evidence is shown of the presence of diethanolamine in the phospholipids, a condition which may slow their metabolisis and be related to the decrease in the output of the choline-containing phospholipids. 22 references.

1359 Autoradiographs with Radioactive Iodine. I. Doniach and S. R. Pelc. Proc. Roy. Soc. Med. 42, 957-9(1949) Dec.

The results of the study of the uptake of I^{131} by the thyroids of rats through a stripping film technique for radioautographs are described. Subcutaneous or intraperitoneal injections of carrier-free I^{131} in doses of 5-50 μc were made; it was found that a dose as small as 0.02 μc could be detected when the animal was killed 19 hr after injection.

Iodine uptake into the follicular colloid of the thyroid occurred within 10 min after the injection; radioautographs taken 4, 7, and 9 days afterwards confirmed a much more rapid turnover of the iodine in the central follicles as compared with the peripheral follicles. The thyroid glands of rats receiving thiouracil before or together with the I^{131} failed to produce radioautographs. After a 6-week course of daily injections of 20 μg of dL-sodium thyroxine, rat thyroids concentrated more iodine within the cells than in the colloid. Other results are included and described.

1360 The Behavior of Labeled Thyroglobulin and Labeled Thyroxine in Patients with Myxedema. A. Albert, Joseph Edward Rall, F. Raymond Keating, Jr., Marschelle H. Power, and Marvin M. D. Williams. J. Clin. Endocrinol. 9, 1392-1405(1949) Dec.

Comparative studies with inorganic iodide labeled with I^{131} in 2 myxedematous patients were made during hypothyroid and euthyroid states. It was found that during myxedema, there was localization of the radioiodide only in residual thyroid tissue; at a normal metabolic level, no thyroidal accumulation occurred. A small proportion of the labeled iodide appeared in the precipitable fraction of serum during myxedema but not during euthyroidism. All of the I^{131} eliminated in the urine appeared in the form of iodide. Two to 4 per cent of the dose was excreted in the feces, all of it organically bound. Comparative studies were also made with labeled thyroglobulin during hypothyroidism and euthyroidism in a patient with spontaneous myxedema; temporary localization of radioactivity occurred over the liver. Within 1 hr, I^{131} appeared in the serum in both precipitable and nonprecipitable form. Similar comparative studies with labeled racemic thyroxine also disclosed considerable amounts of radioactivity over the region of the liver. Radioactivity in serum was initially entirely in precipitable form, after which inorganic iodide appeared. 13 references.

1361 Clinical Use of Radioactive Iodine. Russell Fraser. Proc. Roy. Soc. Med. 42, 962-6(1949) Dec.

The urinary excretion of radioiodine I^{131} was measured in a number of cases where thyrotoxicosis was suspected clinically; the dosage was 10 μc. The final diagnosis ascertained from the therapeutic response corresponded to the I^{131} test in all cases in the absence of obvious renal disease with only two exceptions. These were two instances of nontoxic thyroid enlargement giving results which resembled those in hypothyroidism and which, it is concluded, should not be a serious limitation to the test.

1362 The Detection of Intracranial Tumors by the Use of Di-Iodo^{131}-Fluorescein. Moses Ashkenazy, George V. LeRoy, Theodore Fields, and Loyal Davis. J. Lab. Clin. Med. 34, 1580-1(1949) Nov.

The results of the examination of 60 patients with the differential counter method for diagnosing intracranial lesions are described; this method involves the intravenous injection of radiofluorescein (di-iodo^{131}-fluorescein) in amounts of 0.7-1.0 mc and the detection of greater concentrations of radioactivity in the neoplastic regions. The diagnosis was proved correct in all but one case.

1363 The Distribution of Phosphorus^{32} in the Early Chick Embryo in the Presence of Vitamin D. Louis A. Hansborough and Philip A. Nicholas. J. Expti. Zool. 112, 195-202(1949) Nov.

Vitamin D_3 and P^{32} were injected into the air chambers of purebred Rhode Island hens' eggs before incubation, and a study of the metabolism of the P^{32} in the presence of vitamin D_3 was then made through the use of radioautographs at various stages of development of the egg embryos. It was found that the incorporation of the phosphorus is a continuous process, increasing with the age of the embryo; the phosphorus is utilized by all areas of the embryo. It was also noted that the pattern of phosphorus distribution follows the pattern of cell distribution, the concentration being greatest in those areas containing the greatest amount of cells; the distribution of P^{32} in the early chick embryo is general, and all cells participate in this metabolism without any apparent specificity.

1364 Effect of Halides, Thiocyanate, and Propylthiouracil upon the Distribution of Radioiodine in the Thyroid Gland, Blood, and Urine. Robert H. Williams, Herbert Jaffe, and Jean A. Taylor. Am. J. Med. Sci. 219, 7-15(1950) Jan.

A carrier-free dose of 100 μc of I^{131} was given subcutaneously to each of a group of Sprague-Dawley rats 45 min or longer after the intravenous injection of one of a number of halides or thiocyanate; the animals were sacrificed 1 hr after the I^{131} administration and their thyroids were removed, weighed and analyzed for radioactivity. The effect of the halides and propylthiouracil on I^{131} metabolism was also studied in 6 patients with thyrotoxicosis and in 1 subject with euthyroidism. The compounds tested were given by mouth, except in a few instances; the I^{131} was administered subcutaneously in 100 μc amounts; specimens of urine and serum were collected at intervals (0.5, 1, 2, 4, and 24 hr) after the dose administration. It was found that potassium iodide and potassium thiocyanate markedly inhibited the uptake of the I^{131} by the thyroid in the rats; sodium chloride and sodium bromide did not effect the uptake significantly but increased the excretion of the isotope in the urine. Potassium iodide markedly increased the excretion of I^{131} in the urine; propylthiouracil increased the concentration of I^{131} in the thyroid when it was given for approximately 2 weeks and then discontinued 2 days before administration of the isotope. Some clinical applications of these observations are discussed.

1365 The Examination of the Liquor Circulation by Radioactive Indicators. Joachim Gerlach. Zentr. Neurochirurgie 9, 206-9(1949)(in German).

In two cases the circulation of the cerebrospinal fluid was examined by means of ThX which was injected into the right lateral ventricle and determined quantitatively in the venous blood at regular intervals. It was found that the method is useful diagnostically. Though damage through rays was not observed, the author warns that this diagnostic procedure ought at present to be used with careful reserve.

1366 Labeling of Rat Hemoglobin with Radioactive Iron. Karlman Wasserman and John K. Hampton, Jr. Proc. Soc. Expti. Biol. Med. 72, 639-41(1949) Dec.

A procedure is described which, the authors believe, provides an improved tagging of hemoglobin with radioactive

iron. A mixture of Fe^{55} and Fe^{59} was reacted with an HCl solution and the resulting ferrous chloride was evaporated to dryness and mixed with a solution of lactic acid; this solution was injected in a series of adult male and female white rats which had hematocrit readings previously lowered 25% by intermittent bleedings. During the course of intraperitoneal iron injections (0.25 cc/100 g body weight or 1 mg iron/100 g body weight) four more bleedings were performed; a total of 14 injections were given, of which the third and the tenth were at half concentration; low toxicity of the injected solution was demonstrated and a 25-29% tagging of the hemoglobin consistently occurred. The short duration of the experimental tagging, in addition to the foregoing features, is considered to be of definite advantage.

1367 Metabolism of Labeled Carbon Disulfide in Guinea Pigs and Mice. Cornelius F. Strittmatter, Theodore Peters, Jr., and Ralph W. McKee. Arch. Ind. Hygiene and Occupational Med. 1, 54-64(1950) Jan.

The extent of distribution of carbon disulfide in small guinea pigs and adult mice, and the rate and mode of excretion of the compound were studied with the aid of isotopic sulfur, S^{35}, as a tracer. The radioactive disulfide (CS_2^{35}) was administered to the guinea pigs intraperitoneally, subcutaneously, intracardially, or by exposure to the CS_2^{35} fumes; determinations of the amounts of the compound in the expired air, and in the organs, body tissues, and excreta were made two days after administration and the techniques utilized are described in detail. It was found that a total of 20-50% of the intracardially injected carbon disulfide containing the isotope S^{35} was retained by the guinea pigs, the amount of material retained depending on the size of the dose. There was a general distribution of the retained CS_2^{35} (injected or inhaled) throughout the body tissues, but more S^{35} was present in the liver tissue than in any other tissue studied. Although the nonmetabolized and volatile CS_2^{35} was excreted rapidly (30-60 min) the body tissues retained large quantities of the S^{35} and gave them up slowly. The organism metabolized relatively large quantities of the retained CS_2^{35}, with about 30% of the retained material being excreted in the urine, largely as inorganic sulfates; the feces contained some metabolized S^{35} (5-15%), the amount increasing with the CS_2^{35} administered. Relatively long periods (more than 2 days) were required to saturate completely the tissues with nonreacted and metabolized carbon disulfide and even longer periods of time were required to metabolize and excrete the S^{35}.

1368 A Method for the Preoperative Estimation of Function in Thyroid Tumors: Its Significance in Diagnosis and Treatment. Brown M. Dobyns, Bengt Skanse, and Farahe Maloof. J. Clin. Endocrinol. 9, 1171-84 (1949) Nov.

A method for the diagnosis of and the estimation of abnormal activity in thyroid tumors is presented; this method consists of the measurement of the degree of concentration of radioactivity in the thyroid after the administration of radioactive iodine I^{131}. An adaption of the Geiger-Mueller counter was used for the accurate estimation of the variations in activity within small areas in the thyroid nodules; this adaption consists of a Geiger-Mueller counter with lead shielding except for a very limited area so as to pinpoint

the radiation measurement; the accuracy of the method was demonstrated through the use of radioautographs. After examining 41 cases of nodular goiter pre-operatively by this method the authors reached the conclusions that this method is of value in raising a suspicion of carcinoma, in the diagnosis of hyperfunctioning nodules with or without thyrotoxicosis, and in distinguishing the diffuse hyperfunctioning gland of Graves' disease with an incidental nonfunctioning nodule, from a hyperfunctioning nodule with thyrotoxicosis.

1369 Products of the Oxidation of Glycolic Acid and l-Lactic Acid by Enzymes from Tobacco Leaves. N. E. Tolbert, C. O. Clagett, and R. H. Burris. J. Biol. Chem. 181, 905-14(1949) Dec.

In the present investigation the enzyme from plants which oxidizes α-hydroxy acids was purified further by dialysis and lyophilization, and the resulting dried material was found to have a high oxidation activity. The enzyme was reacted with glycolic acid labeled with C^{14} in the carboxyl carbon or in the α-carbon atom. It was found that the enzyme preparation oxidized glycolic acid, via glyoxylic acid, to formic acid and CO_2; the CO_2 arose from the carboxyl carbon of the glycolic acid. Lactic acid was oxidized to pyruvic acid. It was found that the glycolic acid oxidation was inhibited by high concentrations of oxalic and mesoxalic acid and by ascorbic acid; added hydrazines, semicarbazide, and ethylenediamine bound the glyoxalic acid formed and prevented further oxidation.

1370 Radioactive Carbon Shows Spermaceti in Cold Cream Doesn't Penetrate Skin. Drug Trade News, 41(1949) Dec. 12.

Experiments carried out by Drs. Louis C. Barail and Joseph J. Pescatore on the penetration of cold cream through the skin were reported before the Society of Cosmetic Chemists in New York recently. Radioactive carbon^{14} was incorporated into the spermaceti portion of the cold cream and applied to the skin of freshly shaved rabbits. Results indicated that this fraction of the cold cream is not absorbed through the skin, but the authors stress that this does not preclude the possibility of penetration into the skin by other components of the cream.

1371 The Thyroid Clearance Rate of Plasma Iodine as a Measure of Thyroid Activity. N. B. Myant and E. E. Pochin. Proc. Roy. Soc. Med. 42, 959-61(1949) Dec.

Certain quantitative measures of the rate of uptake of iodine by the human thyroid are described and their clinical applications are discussed; radioiodine, I^{131}, was used as an aid for the determinations. Doses of 30 μc of I^{131}, either without a carrier or with 20 μg of inert iodine, were given orally or intravenously to normal and thyrotoxic patients. The urinary excretion and plasma concentration were followed by conventional methods, and labeled iodide was differentiated from thyroxine in the plasma; the thyroid uptake of the dose was determined by means of a γ-ray counter. It was found that in normal subjects the thyroid continues to take up iodine for two or three days after administration, reaches a peak content of about 33% of the dose, and then gradually loses iodine; in thyrotoxic patients, the maximum uptake is greater, is more quickly reached, and iodine is

lost more rapidly. Equal times are required for both the thyrotoxic and normal subjects to complete the initial urinary excretion and to remove I^{131} from the plasma. The thyroid clearance rate for normal subjects was 5-40 ml/min with an average of 25 ml/min; in 15 subjects with clearly defined thyrotoxicosis, the values always exceeded 100 ml/min. The determination of the plasma iodide concentration 2 hr after an oral administration of I^{131} is suggested as a simple method for finding the degree of activity of the thyroid; for a closer analysis the thyroid clearance rate must be determined.

1372 Tracer Atoms. S. V. Altshuler. Popular Science Library for Soldiers and Sailors. Moscow, War Department U.S.S.R., 1948, 56p (in Russian).

This pamphlet presents a very elementary treatment of the principal phenomena of radioactivity and of the methods of tracer atoms.

1373 Tracer Methods in Biological Research. Martin D. Kamen. In Survey of Biological Progress, Vol. I. New York, Academic Press, 1949, pp 59-88.

This article surveys some of the more salient features of tracer methodology using a restricted number of sample researches as foci for a discussion of achievements and potentialities. Two sections are covered, biochemistry and physiology; under the biochemical applications, such topics as the concept of the "metabolic pool," precursor-product relations, metabolic cycles, detection of intermediates, reversibility of biochemical equilibria, and analysis by isotopic dilution methods are discussed and examples of research are presented. The integration of these studies to others in the field of physiology is noted in introducing a review of application to studies in permeability, absorption and retention of metabolites, metabolic turnover, and transport of metabolites. Medical applications are also mentioned, and future trends and limitations of tracer methods are emphasized. 134 references.

1374 Transport of Radioactive Na^+ and K^+ through Gastric Mucosa. E. Eva Crane and R. E. Davies. Biochem. J. 45, xxiii-xxiv(1949) No. 4.

Experiments with the radioactive ions Na^{24} and K^{42} to discover the flux of Na^+ and K^+ across gastric mucosa were carried out under a variety of conditions. Isolated frog gastric mucosa was used in the experiments. For any one resting mucosa the rate of transport of Na^+ or K^+ remained constant to ±15%, but increased rapidly if the mucosa was mechanically damaged as indicated by the fall of the potential difference across it. The rates of transport of Na^+ and K^+ from the secretory to the nutrient side were almost the same. In the opposite direction the rate of transport of Na^+ was similar; the rate of transport of K^+ was 5% of the rate of Na^+ transport. In nine experiments with K^{42}, the rate of transport of K^+ in both directions was reversibly increased up to sevenfold when histamine was added to the nutrient solution. This increase was not dependent upon the inhibition of acid secretion. Experiments in which an applied electric current was passed through the mucosa in either direction showed that K^+ and/or Na^+ can carry at least part of the current.

1375 Uptake of Labeled Amino Acids by Tissue Proteins in Vitro. Henry Borsook, Clara L. Deasy, Arie J. Haagen-Smit, Geoffrey Keighley, and Peter H. Lowy. Federation Proc. 8, 589-96(1949) Sept.

The uptake of isotopically labeled amino acids (with N^{15}) by the tissue proteins of the rat, rabbit, and guinea pig in vitro was studied and the extensive results are presented here. It was found that all of the tissues so far tested (liver, diaphragm, and bone marrow homogenates and slices) can take up in vitro into their proteins every labeled amino acid presented to them; the most active normal tissue in adult animals was found to be bone marrow. It is concluded that the uptake of every amino acid in every tissue, with one exception (lysine in liver homogenate), is immediately dependent on respiration. The effective range of labeled amino acid concentration is within the order of that in the plasma; and the rate of uptake is comparable to that in vivo. Glycine, leucine and lysine are taken up independently of each other. Evidence yet to be substantiated indicates that the amino acids are taken up in peptide bonds; there is also evidence that in the case of liver homogenate, at least, a synergistic action occurs between two sets of intracellular particles. 26 references.

1376 The Uptake of Radioactive Phosphorus by Gastric Carcinoma in the Human. Seymour J. Gray, John Schulman, Jr., and Marlene Falkenheim. Gastroenterology 13, 501-12(1949) Dec.

Six patients with gastric carcinoma and four patients with duodenal or gastric ulcer were given a single intravenous injection of P^{32} as $KH_2P^{32}O_4$ (1 μc of P^{32}/lb of body weight) approximately 36 hr prior to the scheduled time for subtotal gastric surgery; within 1 hr after the removal of the stomach, the gastric mucosa was stripped from the stomach wall and analyzed for total phosphorus, acid soluble phosphorus, lipid phosphorus, and protein phosphorus in order to determine the rates of turnover of P^{32} by the cancerous and noncancerous gastric mucosa. It was found that gastric carcinoma exhibits a 48.5% higher turnover of phosphorus than the noncancerous tissue. The rate of turnover of protein phosphorus was increased 126% in the cancer tissue; the lipid phosphorus turnover was increased 44%, while there was no change in the acid soluble fraction. It was shown that the increased rate of phosphorus turnover was limited to the cancer itself and not demonstrable in the surrounding tissue. There was no difference in the metabolism of P^{32} between those areas of the stomach where cancer commonly occurs and those where it is rare. The atrophic gastric mucosa metabolizes P^{32} at the same rate as the normal mucosa; the phosphorus content of gastric cancer and noncancerous gastric mucosa is essentially the same. 13 references.

1377 Urinary Excretion of Radioactive Iodine as a Measure of Thyroid Activity. A. Stuart Mason. Proc. Roy. Soc. Med. 42, 961-2(1949) Dec. (See also NSA 3-1864.)

The results of an experiment to determine the accuracy of the 24-hr urinary excretion (of I^{131}) test in measuring thyroid activity are presented. A dose of 10 μc of I^{131} with sodium iodide as a carrier was found to be sufficient and was administered to 49 patients in whom clinical evidence

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indicated normal, increased or decreased thyroid function. In 26 normal patients, the amount excreted was 28-72% as compared with 5-26% in 19 cases of thyrotoxicosis; 4 cases of myxedema indicated values within the normal range. It is concluded that the urinary excretion method is a simple and useful diagnostic aid in determining thyroid activity; bulk samples 6-24 hr after the dose give a clear-cut separation between the normal and the thyrotoxic patient. In myxedema, it is stated, this calculation is of diagnostic use but requires further study, with collection of urine over a 48-hr period.

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1378 Vapor Pressures of Zirconium Tetrachloride and Hafnium Tetrachloride. D. W. Kuhn, A. D. Ryon, and A. A. Palko. AECD-2768, Nov. 2, 1949, decl. Jan. 4, 1949. 4p.

The vapor pressures of $ZrCl_4$ and $HfCl_4$ have been measured over the range from 10 mm to 10,000 mm Hg. The vapor pressure curves of both salts are on an accompanying graph.

1379 The Heat of Formation of CN, N_2, and NO. Leo Brewer and Lieselotte Kamm Templeton. UCRL-529, Nov. 30, 1949. 29p.

The heats of dissociation of N_2, CN, CO and many other important molecules have not been unambiguously determined previously. In this report the production of CN in a resistance furnace and the determination of its heat of formation by using the 0, 1 emission band head is described. Using the value obtained, the dissociation energies for N_2, NO(g), and C_2N_2(g) have been calculated.

1380 Physico-Chemical Properties of Stable Isotopes; Conductivity Measurements of Stable Isotopes. H. R. Bronstein and G. W. Keilholtz. Y-507, Oct. 12, 1949. 28p.

A theoretical discussion is presented on the various factors influencing the conductivity of electrolytic solutions. Mass is the major factor contributing to differences in conductivity of isotopic solutions, and the isotopes of higher mass should have a larger resistance or lower conductivity. A description of the apparatus and techniques is included. Experimental results show that samples enriched with K^{41} have a resistance 0.1-0.2% higher than normal potassium when compared on an equal molar basis. 15 references. (auth)

1381 Nitrogen Purification Process. A. S. Newton (to U. S. Atomic Energy Commission). U. S. Patent No. 2,487,360, Nov. 8, 1949.

A simplified method for the purification of nitrogen by the removal of oxygen is accomplished by passing the impure nitrogen over uranium nitride while maintaining the nitride at an elevated temperature usually not less than 200°C and preferably about 500-600°C.

1382 Color Reaction of Beryllium with Alkannin and Naphthazarin; Spectrophotometric Studies. A. L. Underwood and W. F. Neuman. Anal. Chem. 21, 1348-1352(1949) Nov. (See also AECD-1982 and AECU-345.)

A rapid, sensitive, and accurate spectrophotometric method is described for the determination of microgram quantities of beryllium, using either alkannin or naphthazarin as the reagent. From 1-20 μg of beryllium in 20 ml can be determined with a probable error of less than 3% (standard deviation, 4.5%); as little as 0.1 μg can be determined with somewhat less accuracy. Optimal conditions for the method have been found by studying the various factors that influence the color of the reagent with beryllium, such as pH, dye concentration, time of standing, and various extraneous ions. This method is subject to considerable interference from other elements, so that isolation of beryllium will be necessary in the analysis of biological samples, minerals, alloys, etc., but the method has proved extremely useful where the analysis of fairly pure beryllium solutions is desired; the accuracy, sensitivity, and ease of carrying out the procedure compare favorably with other methods.

1383 Determination of Titanium and Iron; Rapid Control Determination of Both in Same Sample. B. A. Shippy. Anal. Chem. 21, 698-9(1949) June.

The determination of titanium and iron in a single sample by titration of a reduced solution with standard potassium permanganate is described. Methylene blue is employed for the titanium end point and o-phenanthroline ferrous complex is used for the iron. Comparison of potential and indicator breaks is shown.

1384 Gas Analysis; Bibliography of Reports and Published Literature. Atomic Energy Research Establishment Report No. AERE-Inf/Bib-52, Nov. 1949. 50p.

This bibliography of 472 references lists American and British nonsecret reports issued up to Nov. 1949, and papers noted in Chemical Abstracts over the period January 1939 to September 1949, plus a few miscellaneous references. (auth)

1385 Vanadium as Phosphotungstovanadate; A Spectrophotometric Method. M. D. Cooper and Paul K. Winter. Anal. Chem. 21, 605-9(1949) May.

The formation of a complex by the interaction of vanadate, phosphate, and tungstate ions in an acid medium, and the measurement of its absorbancy using the Beckman spectrophotometer, are common to these procedures for the determination of vanadium in low-alloy steels. Four procedures are described. Two involve a preliminary separation by means of sodium bicarbonate; in one case a sulfuric acid medium and in the other a perchloric acid medium is employed. Either procedure, in which electrolysis over the mercury cathode constitutes a final separation of all interfering elements from the vanadium, is recommended where high precision is required. Two alternative procedures, in which the preliminary separation is avoided, are recommended for routine analysis. Their precision as indicated by a standard deviation is approximately 1%, while that of the others is of the order of 0.5 to 0.6%.

1386 Periodic Law of Atom Nuclei. Chemically Analogous Elements in the Periodic Table of Atom Nuclei. A. P. Znoĭko. Doklady Akad. Nauk S.S.S.R. 68, 1021-4(1949)(in Russian).

Continuing the exposition of a periodic arrangement of nuclei, based on a system of curves in which the "specific charges" Z/A are plotted against A, (Doklady Akad. Nauk

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S.S.S.R. 68, 837(1949)), the author derives a table of elements uniting the features of his "structural" periods with those of the periodic reappearances of chemical properties. The periodic changes in the specific charge are tied in with the filling of the various electronic shells.

1387 Periodic Law of Atom Nuclei. Specific Nuclear Charge and Periodic System of Isotopes. A. P. Znoĭko. Doklady Akad. Nauk S.S.S.R. 68, 837-41 (1949)(in Russian).

By plotting "specific charges" Z/A (ordinates) against A (abscissas), a net formed by the following curves is obtained: (1) one set of hyperbolas having the coordinate axes as asymptotes and containing, each, all isotopes of an element; (2) two sets of hyperbolas, symmetrical about the line Z/A = 0.5 which is a common asymptote of the two sets, the other asymptote being the ordinate axis; these hyperbolas intersect the set (1) at points corresponding to β^+ emitters above the line Z/A = 0.5, and to β^- emitters below that line. The set of points thus obtained is found to reflect several periodic regularities in the structure and the stability of nuclei and to furnish clues for predictions con concerning the existence of isotopes, the radiation emitted, the spin values, etc. Five periods are distinguished, each ending with an alkaline-earth metal: Ca, Sr, Ba, Ra, (the fifth period is unfinished).

1388 The Equilibrium $H_2 + HDO \rightleftharpoons HD + H_2O$ and Further Exchange Equilibria in the System H_2, D_2 and H_2O. Hans E. Suess. Z. Naturforsch. 4a, 328-32(1949) Aug. (in German).

The distribution constants of deuterium between hydrogen and water vapor were determined for different concentrations of deuterium in the temperature region from 80-200°C. Within the limit of error (<1%) they are independent of the concentration. The equilibrium constants of the reactions $H_2 + HDO = HD + H_2O$ and $HD + D_2O = D_2 + HDO$ differ, therefore, by less than 3%. The values for the equilibrium constants $K_1 = [H_2][HDO]/[HD][H_2O] \sim K_2 = [HD][D_2O]/[D_2][HDO]$ were determined to be the following:

Temperature (°C)	80	100	120	140	160	200
$K_1 \sim K_2$	2.784	2.573	2.442	2.288	2.168	1.980

These results can be described by the relation $\log K = 928/4.57T - 0.1320$ where T is the absolute temperature.

1389 Apparatus and Process for Production of Fluorine. George C. Whitaker (to U. S. Atomic Energy Commission). U. S. Patent Application Ser. No. 669,502.

Fluorine is produced by electrolyzing an acid potassium fluoride bath containing lithium fluoride with a copper impregnated carbon anode and a steel or iron cathode.

1390 Process for Photochemical Chlorination of Hydrocarbons. Walter S. Beanblossom (to U. S. Atomic Energy Commission). U. S. Patent Application Ser. No. 542,623.

A process for chlorination of a major portion of the hydrogen atoms of paraffinic hydrocarbons of five or more carbon atoms may be replaced by subjecting the hydrocarbon to the action of chlorine under active light. The initial chlorination is begun at 25 to 30°C with the chlorine diluted with HCl. The later stages may be carried out

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with undiluted chlorine and the temperature gradually raised to about 129°C.

1391 Hot Laboratory Technical Report. II. A Sealer and Cutter for Plastic Tubing. Gerald J. Selvin. BNL-28, Sept. 1, 1949. 8p.

An instrument has been devised to heat-seal and cut thermoplastic tubing commonly used in the laboratory. This operation is accomplished from a distance of 3 ft in the present device, although minor modifications would permit its use at other distances. Two jaws, heated electrically by resistance wire, are mechanically closed with the tubing between them so as to effect the seal. One jaw has a centrally located fixed raised nib, which produces the cut only after the tube has been heated sufficiently to seal it closed. (auth)

1392 Hot Laboratory Technical Report. III. A Totally Sealed Rotating Funnel. Gerald J. Selvin. BNL-29, Sept. 1, 1949. 6p.

An improved method for directing liquid flow in a closed system is described. The device consists of a funnel which is caused to rotate to any one of several discharge ports. Solenoids and glass-enclosed ion slugs provide the means of operation.

1393 A Digest of Laboratory Safety Practices. James S. Sweely. Chem. Eng. News 27, 2861-4(1949) Dec. 26.

A survey is given of the safety practices of nine large laboratories engaged in petroleum refining, chemical manufacture, rayon production, and government research. Special emphasis is placed on the handling of distillation and vacuum equipment, pressure equipment, and electrical and gas-fired equipment.

1394 Liquid Air Level Control. Mark S. Fred and Everett G. Rauh. ANL-4381, Dec. 13, 1949. 5p.

Reported here is a simple device which automatically maintains within predetermined limits the level of liquid air or liquid nitrogen in a bath. Control is based on the large negative temperature coefficient of resistance of an ordinary carbon resistor. By incorporating the resistor in a voltage divider there is obtained, with a change of temperature of the resistor, a large voltage change which actuates an electronically controlled liquid air pump. The chief advantage of this system is its flexibility obtained because the controlling elements require very little space and may be adjusted for a wide range of requirements. Control has proved to be positive and reliable.

1395 Remote Control Manipulator. John H. Payne, Jr. (to U. S. Atomic Energy Commission). U. S. Patent No. 2,476,249, July 12, 1949.

This remote control manipulator permits an operator, seated behind a protective wall, to control the movements of a pair of artificial hands located on the far side of the protective wall. The actual hands are similar to the double hooks used by amputees. The control is effected by means of cables and pulleys so arranged that the artificial hands move in space in the same manner as the handles controlled by the operator.

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1396 Investigation of Color Centers in Alkali Halide Crystals. Ruth Casler and P. Pringsheim. AECU-658(UAC-174), 1949. 32p.

The following topics have been investigated: (1) specific action of slow neutrons in the formation of F-centers in lithium fluoride; (2) stability of F-centers in potassium bromide; (3) ultraviolet and infrared bands in potassium bromide.

Bound with the report are the following: New Ultraviolet and Infrared Bands in Various Alkali Halides, by P. Pringsheim; Influence of Temperature During Irradiation on the Development of Color Centers, by P. Pringsheim; and Influence of Temperature During Irradiation on the Development of Color Centers, by Ruth Casler, P. Pringsheim, and P. Yuster.

1397 Chemical Effects of Nuclear Recoil. A. G. Maddock. Research 2, 556-63(1949) Dec.

Up to the present time little work has been done on the chemical effects of nuclear recoil. Earlier work is outlined in the article, and expressions are given for the recoil energies in several possible types of nuclear reactions. The effect of α decay on uranium compounds is discussed. (n,p) reactions initiated by slow neutrons were studied and the effects of recoil on resulting sulfur compounds are described in detail. Some work was also done on reactions which involve two consecutive recoils. A simple theory is given for the Szilard-Chalmers effect in the alkyl halides and in the oxyanions, and the author concludes with several remarks about electron recoil processes. It is noted that experimental results in this field do not agree with the proposed theories, and a new line of approach is suggested. Further investigation of the chemical effects of decay might lead to evidence of the existence of the neutrino.

1398 The Effects of Radioactivity on Oleic Acid. Virginia L. Burton. J. Am. Chem. Soc. 71, 4117-19(1949) Dec.

Purified oleic acid has been bombarded with deuterons in the M.I.T. cyclotron. Analysis of the irradiated material has revealed the formation of stearic acid, heptadecene, and polymerized acids. It has been shown that the hydrogen produced by decomposition of an organic molecule under the influence of radioactivity can enter the double bond of a neighboring molecule. It has thus been demonstrated that hydrogen which may be produced by the effects of radioactivity on the organic constituents of a petroleum source sediment could, in part, be removed from the gas phase by reaction with unsaturated components of the sediments.

1399 On α-Br-(d-Camphor)-π-Sulfonates of the Left Wing of Rare-Earth Elements. Ya. Ya. Dodonov and K. F. Protyanova. Doklady Akad. Nauk S.S.S.R. 68, 861-4(1949)(in Russian).

An attempt was made to use α-Br-(d-camphor)-π-sulfo-acid for the separation and determination of rare earths, its advantages being (1) the formation of well-crystallized salts with many cations, (2) its high molecular weight, facilitating fractional crystallizations of small volumes, and (3) its optical activity, permitting purity tests. The experiments, involving individual salts of La, Ce, and Nd, showed very satisfactory quantitative yields and characteristic coefficients of optical rotation. No separations and analyses of mixtures were made.

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1400 The Quantitative Separation of Beryllium from Aluminum. W. C. Coppins. Analyst 74, 317-18 (1949) May (Note).

When a caustic alkaline solution of beryllium and aluminum is neutralized with dilute acid, the beryllium hydroxide starts to precipitate first, and on subsequent boiling precipitation of beryllium is quantitative while aluminum remains in solution. Indigo carmine may be use as indicator to show the correct alkalinity. With a large excess of aluminum double precipitation from the caustic alkaline solution is necessary.

1401 A Study of the Ion-Exchange Equilibria between Hydrogen Ion and Sodium, Calcium, Barium, and Cerium Ions. Jacob A. Marinsky. M.I.T. Laboratory for Nuclear Science and Engineering Technical Report No. 34, Aug. 15, 1949. 80p. (NP-1245.)

Studies have been made of cation-exchange reactions between the synthetic resin, Dowex-50, and solutions containing the following pairs of cations: hydrogen-sodium, hydrogen-calcium, hydrogen-barium, and hydrogen-cerium. The concentration ratio of these cation pairs in the resin phase has been varied over a range of 10^4 to 10^5 to test fully several mass-action equations which previous workers claimed would represent these reactions. It has been established from material balance studies that exchange of cations occurs on a simple equivalent basis. After suitable estimation of the activity of the ions in the aqueous phase it has been found that the proposed mass-action expressions investigated do not simply satisfy the equilibrium governing these reactions. The K_a values obtained for the hydrogen-sodium system with the mass-action expressions tested increase from a value of 1.45 ± 0.10 to 1.75 ± 0.17 as the mole fraction function increases from 10^{-1} to 1. The values of K_a appear to be constant to 1.75 as the mole fraction function becomes greater than 1. The K_a values calculated for the hydrogen-calcium and hydrogen-barium systems show a very similar dependence of K_a on the mole fraction function. The values of K_a decrease from 47 and 248 to 29 and 30 (classical treatment) as this function increases from about 10^{-3} to about 0.7. The high values for K_a differ by a factor of 5.3 while the lowest values for K_a at high metal content differ by nearly the same factor, namely 4.5. The mole fraction function for these systems when the value of K_a is midway between the limiting values observed is 0.06 for the hydrogen-calcium reaction as compared to 0.05 for the hydrogen-barium system. The K_a values obtained for the hydrogen-cerium experiments performed at two ionic strengths (about 0.2 and about 1.1) become constant when the mole fraction function is smaller than 2×10^{-3}. As the value of this function increases, the fall in K_a value is about a factor of 4 or 8 times greater than was noted in the equilibria with calcium and barium. The trend of K_a values obtained with the statistical thermodynamic expression are similar to those observed when the classical treatment is applied, and a hypothesis of intermediate compound formation is presented as a possible explanation of the results obtained. It is pointed out, however, that additional experimental information is necessary for its complete evaluation.

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In addition, the experimental methods are outlined to test further this hypothesis and several others. 62 references. (auth)

1402 Synthesis of Formaldehyde-C^{14}. A. R. Jones and W. J. Skraba. AECU-636(ORNL-379), Nov. 14, 1949. 14p.

Methanol-C^{14} has been converted to formaldehyde-C^{14} in yields of approximately 60% by the following procedure. Methanol-C^{14} was acetylated with acetyl chloride. The methyl-C^{14} acetate was monochlorinated and the crude product hydrolyzed with water. The hydrolysis mixture was diluted with carrier formalin solution, neutralized, and distilled to dryness, producing a neutral aqueous solution of formaldehyde-C^{14}. (auth)

1403 The Synthesis of Thiourea Labeled with C^{14}. C. Wayne Bills and Anthony R. Ronzio. AECU-660, nd. 4p.

The laboratory scale procedure outlined here is described in detail in the report. Barium carbonate labeled with C^{14} was reacted with ammonia in the presence of barium metal and ferric nitrate catalyst. The barium amide formed was fused to barium cyanamide. This fusion product was reacted with hydrogen sulfide in the presence of an excess of hydroxide. The barium was precipitated as barium carbonate and removed by filtering. The final product was purified by alcohol extractions and by successive crystallizations.

1404 β-Iodoethyldiethylamine Hydroiodide (Triethylamine, 2-iodo-hydriodide); $(CH_3CH_2)_2$-NCH_2CH_2-OH + 2HI → $(CH_3CH_2)_2$-NCH_2I·HI + H_2O. C. Wayne Bills and Anthony R. Ronzio. AECU-661, nd. 2p.

This is not an abstract; the document is reproduced below in its entirety.

Procedure. To 85 ml (128 g, 0.47 moles) of 47% hydriodic acid in a 250-ml flask equipped with an attachment for optional distillation or refluxing are added with caution (Note 1), about 17 drops of 30% hypophosphorous acid. The solution is refluxed for 5 min. If the iodine color has not been discharged, further additions of hypophosphorous acid, one drop at a time followed by refluxing, are continued until the color is gone (Note 2). The flask is then removed from the apparatus, cooled by immersion in a salt-ice bath, and 20 g (0.17 moles) diethylaminoethanol added, with stirring, at such a rate that the mixture does not boil.

When the addition has been completed, the condenser is arranged for distillation and the flask heated slowly to boiling. Fifty-five ml of liquid (consisting chiefly of water) are removed over a 4 hr period, then the mixture is allowed to stand overnight (16 hr) (Note 3). The solution again is heated and 5 ml of liquid are distilled off and collected during 8 hr. The mixture is again allowed to stand overnight. Should the iodine color reappear at any time it is discharged with one or two drops of hypophosphorus acid.

The solution is then chilled and 46.8 g of very faintly yellow colored crystals are filtered off. The mother liquor, on evaporation to a thick syrup and dissolution in the minimum amount of boiling ethanol, followed by cooling, yields an additional 4.2 g of crude product, for a total of 51 g (84%) mp 132-135°. Recrystallization from ethanol (51 g in

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100 ml) gives 45.9 g (76%) of very pale yellow plates, mp 135-6°, (Note 4).

Notes. 1. Hypophosphorous acid is a powerful reducing agent. Care should be exercised in the addition of the acid. An excess of hypophosphorous acid will decompose at the temperature of the reaction with the formation of phosphine and consequent danger of an explosion. 2. With care, even highly colored HI may be decolorized and used in the preparation. 3. This synthesis is arranged for 8 hr working days over a period of 3 days and 2 nights. The 16 hr overnight periods may be materially shortened without harm. 4. The β-halogenated ethylamines show vesicant and other toxic action ("nitrogen mustard") and care should be exercised in this synthesis. Rubber gloves are advisable during the preparation. Care should be taken that the hands do not touch either the eyes or face. It is advisable to give first the eyes, then the face and hands a wash with 4-5% solution of sodium thiosulfate at the end of each working period. All equipment used in this preparation should be neutralized in either a chromic acid-sulfuric acid bath or in sodium thiosulfate solution.

Methods of Preparation. β-Iodoethyldiethylamine hydriodide has been prepared by heating the alcohol with fuming hydriodic acid and red phosphorous (Ladenburg, Ber., 5, 1147(1882)). The present procedure may be used for the preparation of higher members of this series of compounds.

1405 Micro Synthesis with Tracer Elements. XII. The Synthesis of Silver Cyanate Labeled with C^{14} and of Urea Labeled with C^{14} and N^{15}. D. L. Williams and Anthony R. Ronzio. AECU-662, nd. 12p.

The suggestion has been made that urea labeled with both C^{14} and N^{15} should prove to be the ideal compound for complete study of the metabolism of both carbon and nitrogen in urea. Accordingly, the synthesis of urea by the classical conversion of ammonium cyanate to urea was undertaken. A detailed description of the following steps is given. (1) By means of tracer studies it was determined that in the reaction mechanism of the formation of potassium cyanate by fusion of urea with potassium carbonate, the C^{14} in the cyanate is contributed entirely by the urea. Consequently, C^{14}-labeled urea was required as a starting material. (2) C^{14}-labeled potassium cyanate was prepared by the above method. (3) C^{14}-labeled silver cyanate was prepared by reaction of potassium cyanate with silver nitrate. (4) Ammonium chloride labeled with N^{15} was prepared from ammonium nitrate. (5) Ammonium cyanate labeled with both C^{14} and N^{15} was prepared by reaction of silver cyanate with ammonium chloride. (6) The ammonium cyanate was converted to urea in alcohol solution.

1406 Micro Synthesis with Tracer Elements. XIII. The Synthesis of Urea Labeled with N^{15}. D. L. Williams. AECU-664, nd. 3p.

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A sample of urea labeled with N^{15} and C^{14} was desired for a study of the carbon and nitrogen metabolism of the compound.

Samples of doubly labeled compounds may be of two types: either the product of a synthesis involving both desired isotopes, or a mixture of two products, each

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bearing one of the desired isotopes. A mixed sample has the advantage of being more easily prepared, and the disadvantage of having a lower concentration of either isotope.

The synthesis of doubly labeled urea is a difficult and lengthy one, with consequently lower yields. In a preparation of this kind the isotopic concentrations are C^{14}, 4%; N^{15}, 50%. In a 1:1 mixed sample, these concentrations would be reduced to 2 and 25%, respectively. Where such dilution is acceptable, use of the mixed sample is desirable.

Urea labeled with C^{14} is available; the synthesis of the N^{15} labeled compound is reported here.

Experimental. Silver Cyanate: Excess 0.1N barium nitrate was added to a solution of 5 g potassium cyanate (Baker) in 50 ml water to remove the carbonate invariably present in potassium cyanate. The precipitated barium carbonate was filtered off. To the clear solution was added 10% silver nitrate in excess of the amount required to precipitate the cyanate completely. The flocculent white precipitate of silver cyanate was collected on a Buchner funnel, and washed with cold distilled water until the filtrate gave only a faint test for silver when tested with dilute sodium chloride. (The faint test for silver is due to the slight solubility of silver cyanate in water). The silver cyanate was dried in a vacuum desiccator over calcium chloride.

Ammonium Cyanate Labeled with N^{15}: In a 40-ml centrifuge cone were thoroughly mixed 0.1535 g (0.00287 mole) of N^{15} ammonium chloride, 0.6105 g (0.00407 mole) of silver cyanate (40% excess) and 10 ml of distilled water. The mixture was stirred rapidly for 7 hr at such a rate that the unreacted silver cyanate and precipitated silver chloride were kept in suspension. The mixture was then filtered and the filtrate, containing a trace of silver cyanate, and the ammonium cyanate, was transferred to a 250-ml round bottomed flask with a ground glass joint. The silver chloride, silver cyanate precipitate and the cone were washed with 100 ml of absolute ethanol. The washings were added to the filtrate.

Urea Labeled with N^{15}: The flask containing the alcoholic solution of ammonium cyanate was tightly stoppered and was heated in an oil bath for 16-1/2 hr at 55°. (Only a slight test for cyanate ion is given by the solution after 5 hr of heating). The alcoholic solution was quantitatively transferred to a 250-ml beaker and evaporated to dryness. The dry residue was extracted with 40 ml of absolute methanol. The extract was transferred into the vacuum sublimator and evaporated to dryness. The product was purified by sublimation during two 3 hr periods at a temperature of 68-70°C and under a vacuum of 0.002-0.003 mm. After the first sublimate was removed at the end of 3 hr, the residue was redissolved in alcohol, the alcohol removed by evaporation, and the residue again sublimed. The product weighed 0.1465 g (85.4% of the theoretical yield) and melted at 131-2°C.

Summary 1. Pure silver cyanate was prepared from commercial potassium cyanate. 2. N^{15} labeled ammonium cyanate was prepared by the reaction of N^{15} ammonium chloride and silver cyanate. 3. N^{15} labeled urea was obtained by heating N^{15} labeled ammonium cyanate in a solution of ethanol. The product was purified by sublimation.

1407 An Analytic Study of the Conversion of Barium Carbonate to Acetylene. Seymour Monat, Chain Robbins, and Anthony R. Ronzio. AECU-672, nd. 6p.

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Acetylene was synthesized using excess barium metal, by the following reactions:

$$(1)\ 5Ba + 2BaCO_3 \xrightarrow[He]{Fusion} 6BaO + BaC_2;$$

$$(2)\ BaC_2 + 2H_2O \longrightarrow Ba(OH)_2 + C_2H_2.$$

The yield of acetylene based on barium carbonate was determined by reacting the acetylene with excess standardized silver nitrate in the presence of ammonium hydroxide and back-titrating the excess silver nitrate. It was found that yields ranging from 97.8-98.9% of theoretical could be obtained if the acetylene formed were removed from the reaction flask by scrubbing with nitrogen gas and boiling a minimum of 15 min.

1408 The Hydrolysis of Iodine and a Reaction with "Propanol." J. W. Kennedy. BNL-30, Dec. 1, 1949. 9p.

It has been previously reported that small concentrations of n-propanol greatly inhibit the iodide-iodate reaction, $5I^- + IO^-_3 + 6H^+ = 3I_2 + 3H_2O$. Further experiments with this reaction have been carried out and are described in this report. Kinetic studies in acid solutions and in alkaline solutions have been made and the results summarized. The kinetic studies in acid solution give good evidence for the existence of a species not before reported, I_2OH^-. The nature of the reaction has been studied by use of I^{131} as a tracer in acid and in alkaline solution, with the following results: (1) in acid, the I_2 is converted to some species which is extracted very poorly into chloroform (from strong acid or acetate buffered solutions) or into toluene (partition coefficients in every case at least 20 in favor of the aqueous phase); (2) the acid reaction product, which contains a large excess of IO_3^-, produces an inactive precipitate of $AgIO_3$ when treated with excess $AgNO_3$; on several days standing, an AgI precipitate forms which carries all the radioiodine; (3) the alkaline reaction produces a transient organic substance which can carry roughly 7% of the radioiodine from either alkaline or acid solution into a chloroform extract; on standing for 1 hr or more, the chloroform extracts, carefully washed with water, develop the lavender color of free iodine; (4) the principal alkaline reaction product containing radioiodine is simply iodide ion, which may be precipitated from ammoniacal solution as AgI; (5) the acid reaction product very probably splits off I^- ion when made alkaline; this is because, when made acid, again 100% of the original iodine reappears as I_2, through reaction of this I^- with excess IO_3^-.

1409 Isotopic Exchanges of Iron. I. Ch. Haenny and G. Rochat. Helv. Chim. Acta 32, 2441-4(1949) Dec. 1 (in French).

These studies were made with the aid of radioactive iron 59, purified by methods previously described (Haenny et al, Helv. Chim. Acta 32, 1406(1949)). In general the experimental techniques and results are very similar to those reported by Ruben, Seaborg, and Kennedy (J. Applied Phys. 12, 308(1941)). The authors come to the following conclusions: Perfect complex ions such as $Fe^{II}(CN)_6^{-4}$ and $Fe^{III}(CN)_6^{-3}$, do not dissociate and, therefore, do not permit

any observable interchange between the central iron ions and the simple ferric ions. Less perfect complex ions such as those of ferric oxalate do dissociate and there is consequently a rapid interchange with the simple ferric ions. When perfect complex ions, which differ only by their valence states, are placed together in solution, there is a rapid interchange of electrons from one ion to the other.

1410 Isotopic Exchanges of Iron. II. Ch. Haenny and E. Wikler. Helv. Chim. Acta 32, 2444-52(1949) Dec. 1 (in French).

The work of section I (Haenny and Rochat, Helv. Chim. Acta 32, 2441(1949)) is extended to other ions, the experimental techniques being similar to those described in the first section. The authors draw the following conclusions: The iron of the methemoglobin is not exchanged with simple ferric ions. The exchange of iron between the ferricyanide and ferric ions seems to be accelerated by the action of light or of iodine. Electronic exchange between ferrocyanide and ferricyanide seems to be complete in less than 10 min. Iron atoms of ferric oxalate, like those of ferric sulfocyanide are rapidly exchanged with simple ferric ions.

1411 O^{18} Used as an Indicator in Heterogeneous Catalysis. S. M. Karpacheva and A. M. Rozen. Doklady Akad. Nauk S.S.S.R. 68, 1047-60(1949)(in Russian).

Unlike H^2, heavy oxygen has been seldom used in the study of the mechanism of chemical reactions. Since oxygen enters into the composition of many catalysts, the advantage of using O^{18} for the elucidation of catalytic processes is evident. The authors employed that method in the study of the following three reactions: oxidation of hydrogen on various catalysts (chamotte, quartz, dunite), oxidation of CO on MnO_2, and dehydration of alcohol on kaolin and on a mixture of Cr_2O_3 and Al_2O_3. In all cases the catalyst, prior to the reaction, was acted upon by H_2O^{18} vapors at various temperatures; the quantity of absorbed O^{18} was determined from the density decrease of water. It was found that in most cases the catalytic process consists of a formation of intermediate products, only in a few catalysts the mechanism being of a purely "adsorptive" character; on the other hand, in many cases both mechanisms are at work.

1412 Quantitative Determination of α Aminoacids in Paper Chromatograms and Ionopherograms with the Aid of Radioactive Copper. T. Wieland, K. Schmeiser, E. Fischer, and H. Maier-Leibnitz. Naturwissenschaften 36, 280-1(1949)(in German).

The property of aminoacids to form complex compounds with copper is used for a quantitative determination of α aminoacids in filter-paper chromatograms and ionopherograms. Copper acetate solution is spread by capillarity over a ready filter-paper chromatogram, or, in another method, the paper, before the chromatographic procedures, is treated with copper acetyl-acetone. By using Cu^{64} (12.8 hr), the analysis is carried out either by measuring the activity of various strips cut out from the paper chromatogram (or ionopherogram, or by measuring photometrically the darkenings produced by the latter on a photographic plate.

1413 A Radioactive Tracer Method for the Analysis of Mixtures of Short-lived Free Radicals. R. W. Durham, G. R. Martin, and H. C. Sutton. Nature 164, 1052-3(1949) Dec. 17 (Letter to the editor).

A tracer technique for the detection and estimation of the short-lived aliphatic free radicals using radioactive iodine is given. The free radicals are allowed to react with iodine labeled with 8-day iodine-131, and the resulting alkyl iodides, likewise labeled, are frozen out in liquid air. At the conclusion of the experiment, excess iodine is removed, and about 1 cc of carrier for each of the alkyl iodides involved is added. After separation by fractional distillation, and conversion of each fraction into silver iodide, simple β-particle counts give directly the relative proportions of the various radicals initially present. Also given are a dynamic method for the estimation of the radicals, and results of investigations of the photodecomposition of ketones in a static system by the use of radioactive iodine.

1414 Crystal Chemical Studies of the 5f-Series of Elements. XII. New Compounds Representing Known Structure Types. W. H. Zachariasen. Acta Cryst. 2, 388-90(1949) Dec.

The paper summarizes crystal-structure information for 55 new compounds of 4f- and 5f- elements representing 13 known structure types, namely compounds isostructural with NaCl, CaF_2, LaF_3, PbFCl, ZrF_4, La_2O_3, sodium uranyl acetate, K_3ZrF_7, Cu_2Mg, $CaTiO_3$, UO_2F_2, hexagonal $LaPO_4$, and UCl_4.

1415 The Crystal Structures of CeB_4, ThB_4, and UB_4. Allan Zalkin and D. H. Templeton. AECD-2762, Nov. 22, 1949, decl. Jan. 4, 1950. 4p.

The compounds CeB_4, ThB_4, and UB_4 have been shown to crystallize in a new structure, which has been worked out from x-ray diffraction patterns. This structure is designated as the "ThB_4-type structure," since that was the compound first observed. These borides were prepared by heating the metals and boron together in vacuum at about 1,500°C. Powder diffraction patterns were obtained of the 3 compounds. The compounds were assigned formulas of the type MB_4, in agreement with the deduction, from the phases observed in various preparations, that the composition is between MB_2 and MB_6.

1416 The General Electric X-ray Photometer and Its Application to the Determination of Uranium. I. Instrument Modifications. T. W. Bartlett, R. B. Bauder, J. H. Lykins, E. B. Olszewski, and R. H. Lafferty, Jr. AECD-2765, Mar. 4, 1949, decl. Jan. 3, 1950. 26p.

A brief discussion of the theory of x-ray absorption, a description of the General Electric x-ray photometer, and a summary of the work done at the K-25 laboratories with this instrument are presented. Several changes were made in the instrument, including changes in absorption cells, the method of reading, and the x-ray tube. A powder supply with thyratron regulated voltage was tried but found to be less satisfactory than line voltage. Data on the sensitivity and the precision of the instrument are presented and factors affecting sensitivity are discussed. The maximum sensitivity obtained was 28 scale divisions/g of uranium/l and the 95% symmetric confidence interval for a single reading was approximately 3%. A photograph and a diagram of the instrument, calibration curves for uranium

solutions, and photographs of absorption cells are presented. (auth)

1417 The General Electric X-ray Photometer and Its Application to the Determination of Uranium. II. Determination of Uranium in Solutions. T. W. Bartlett. AECD-2766, Oct. 28, 1949, decl. Dec. 29, 1949. 20p.

The precision of the General Electric x-ray photometer as determined by replicate readings on a standard thickness aluminum block and on standard uranium solutions containing up to ±10.0 g of uranium/l was represented by a 95% symmetric confidence interval of 0.65 scale divisions. From equations of calibration curves, this confidence interval was estimated to correspond to ±0.05 g of uranium/l. Absolute errors in excess of 0.1 g of uranium/l occurred because of failure of the calibration points to fall exactly on a straight line. The range of uranium concentrations which may be used in the x-ray photometer was found to be 0.07 to 90 g of uranium/l when the 30-ml L-shaped absorption cells are employed at a primary voltage of 100. The extent of interference by the elements investigated increased as the atomic number increased with the exception of silver and iodine. Examples of the apparent uranium content in g/l of 1% solutions of several elements were as follows: sodium, 0.3; iron, 2.7; molybdenum, 6.1; silver, 5.0; lead, 8.8. As a result of these interferences, satisfactory accuracy for most purposes could be achieved only by a chemical separation of uranium from interference prior to measurement on the x-ray photometer. (auth)

1418 The Trace Analysis of Silicon in Vanadium and Uranium; A Spectrophotometric Method. Ruth Guenther and Richard H. Gale. AECD-2792, Nov. 8, 1949, decl. Jan. 30, 1950. 10p.

A spectrophotometric method for the determination of silicon in vanadium and uranium metals has been developed. The metal is removed by chloroform extraction of its cupferrate, the silicomolybdate color is developed in the residual solution, and the transmittancy is determined at 390 mμ. The system shows an adherence to Beer's Law over the range of 0.02-0.28 mg Si/100 ml with a reproducibility of ±0.004 mg Si/100 ml. (auth)

1419 On the Classification of the Spectrum of Singly-Ionized Uranium. J. R. McNally, Jr. Y-494, Oct. 12, 1949. 5p. (See also NSA 2-1743.)

Previous investigations of the spectrum of singly-ionized uranium (UII) have indicated that two, as yet unconnected, systems of energy states exist. The author states that wavelength data supports the supposition that the energy separation of the two systems is between 2,000-6,000 cm^{-1}. A search for new levels is being undertaken using IBM equipment and about 3,000 selected lines from the MIT Wavelength Tables in an attempt to discover the connecting levels between the two energy states.

1420 The Freezing Point of Uranium. Andrew I. Dahl and Harold E. Cleaves. J. Research Natl. Bur. Standards 43, 513-517(1949) Dec.

The freezing temperature of uranium of about 99.99% purity was measured with an optical pyrometer and found to be 1,133 ± 2°C. Both the initial purity and the initial

freezing temperature were lower than the foregoing values. However, holding the metal at temperatures just above the melting point for several hours resulted in a decrease in the content of several impurities and an increase in the freezing temperature to a final constant value. The freezing temperature was not greatly affected by the crucible material, similar values being obtained in beryllium, thorium, and graphite crucibles.

1421 On the Complex Chemistry of the Uranyl Ion. II. The Complexity of Uranyl Monochloroacetate. A Comparative Potentiometric and Extinctiometric Investigation. Sten Ahrland. Acta Chem. Scand. 3, 783-808(1949). (See also NSA 3-2163.)

This is a continuation of previous work by the author (Acta Chem. Scand. 3, 374(1949)). The complexity of uranyl monochloroacetate has been investigated according to two methods: potentiometrically (by pH-measurements with the quinhydrone electrode) and extinctiometrically (at the Hg-line of 3,130 A). Both methods indicate that the complex formation is entirely mononuclear; there is no sign of polynuclear complexes. The complexity constants of the three mononuclear complexes existing in the range of concentration used are calculated according to both methods. The results agree quantitatively. The conclusion is that potentiometric and extinctiometric methods of measurements of complexity give consistent results if properly used. The constants obtained may, therefore, with great certainty be considered as the true constants according to the law of mass action.

1422 Precipitation of Ammonium Diuranate. Arthur J. Miller and Gerald M. Armstrong (to U. S. Atomic Energy Commission). U. S. Patent No. 2,466,118, Apr. 5, 1949.

A process for the precipitation of ammonium diuranate from aqueous solutions containing uranyl ions and fluoride ions consisting of adding sufficient ammonium hydroxide to the solution to precipitate a major portion of the uranium as ammonium diuranate, digesting the resulting slurry at an elevated temperature of 55 to 75°C, for about 5-20 min, cooling to about ambient temperature and then adding additional ammonium hydroxide to prevent complexing of uranyl ions by fluoride ions and obtain complete precipitation of the uranium.

1423 Producing Thin Film of Metal Oxide. Katheryn E. Langwill (to U. S. Atomic Energy Commission). U. S. Patent 2,486,955, Nov. 1, 1949.

A method is described for forming a thin, smooth, adherent uranium oxide coating of uniform thickness on a polished platinum disc. An amyl acetate solution of UO_2Cl_2 is prepared containing about 2 mg of the chloride/ml of amyl acetate and about 8% by volume of an organic solvent solution for a binder. The solution is sprayed onto the platinum disc and then heated to 600°C. This converts the UO_2Cl_2 into U_3O_8. The spraying and heating operation is repeated until the coating has been built up to approximately half a ml of U_3O_8/cm^2.

1424 Study of Magnetic Properties of Some Complex Compounds of U IV, Having the Coordination Number Eight. Luigi Sacconi. Atti accad. naz. Lincei 6, 639-45(1949)(in Italian).

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In the course of a study of complex compounds of tetravalent uranium with the coordination number eight, the author obtained several uranium-organic compounds by the reaction of hydrochloric acid solutions of the U^{+4} ion with various diketones and nitroso-compounds. Measurements of the magnetic susceptibility of these substances was made in view of a determination of the nature of chemical bonds involved; furthermore, a better insight might be gained into the electronic configuration of U IV. The usually accepted configuration $6s^2 6p^6 6d^2$ was found to disagree with the magnetic properties observed. Only the presence of two 5f electrons in U IV can account for the typical covalent bonds revealed by the magnetic measurements. The true configuration is, accordingly, $5f^2 6s^2 6p^6$.

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1425 Large Current Homopolar Generator. A. H. Barnes, F. A. Smith, and G. K. Whitham. ANL-4361, Oct. 27, 1949. 14p.

A description is given of a homopolar generator which was constructed to supply large direct currents for driving a direct current conduction type electromagnetic pump. A feature of the machine is the use of NaK alloy as a liquid brush. Currents of 20,000 amp at 0.5 v could be supplied continuously at efficiencies of over 60%. Currents of 45,000 amp could be obtained for short intervals. Performance curves are included. (auth)

1426 Adjusting Arrangement for Pneumatic Relays of the Force-Balance Type. Floyd B. Newell (to U. S. Atomic Energy Commission). U. S. Patent No. 2,446,385, Aug. 3, 1948.

An arrangement for adjusting pneumatic relays of the force-balance type of simple and reliable design manufacture.

1427 Dispensing Nozzle. Oran E. Miller (to U. S. Atomic Energy Commission). U. S. Patent No. 2,492,365, Dec. 27, 1949.

A liquid dispensing nozzle useful for filling containers has an automatic cutoff valve arrangement which is responsive to the liquid level in the container being filled, but is not responsive to the vapor pressure of the liquid. The nozzle is especially adaptable for use with liquids of high vapor pressure such as liquid nitrogen.

1428 Locating and Welding Fixture. Edward Colbert (to U. S. Atomic Energy Commission). U. S. Patent No. 2,431,732, Dec. 2, 1947.

A fixture adapted for use in first locating accurately and then welding to each other various valve parts.

1429 Positive Shutoff Dispensing Nozzle. Vinton D. Carver and Clifton B. Graham (to U. S. Atomic Energy Commission). U. S. Patent No. 2,489,028, Nov. 22, 1949.

A liquid dispensing nozzle useful for filling containers automatically closes in response to the vapor pressure of the system being filled. This valve is especially useful in dispensing highly vaporizable liquids such as liquid hydrogen.

ENGINEERING

1430 Radioactive Element. Paul M. Platzman. Textile Industries 113, 90-3(1949) Dec.

Polonium is used in a device called the Alphatron for the elimination of static electricity. It is a decay product of the uranium-radium series and essentially emits α particles. The particles in passing through air ionize the gas molecules forming positive and negative ions. This causes the air to become conductive and dissipates the accumulation of static electricity in nearby objects. Heat, pressure, and humidity have relatively no effect on the α radiators. The Alphatron is now being used in the textile industry (Darlington Fabric Co. of Newton, N. J.) for static elimination of six high speed Sipp-Eastwood silk system warpers. No data is available yet covering dual static eliminating equipment.

1431 Switching and Timing Unit for Pneumatic Relays. Kenneth L. Tate (to U. S. Atomic Energy Commision). U. S. Patent No. 2,441,044, May 4, 1948.

A pneumatic damping and switching unit whereby the piping connections in a pneumatic relay of a force-balance can be simply interchanged so that the reset function of the relay may be omitted or the timing rate of said reset function may be changed to any one of several values.

1432 Voltage Doubling Circuits. William W. Hansen (to U. S. Atomic Energy Commission). U. S. Patent No. 2,493,137, Jan. 3, 1950.

A voltage doubling circuit for translating the potential of a primary source of energy to a potential of greater magnitude, particularly advantageous in the field of x-ray photography where an extremely short exposure time is desired.

1433 Engineering Research Progress Report No. 1 on Boiling Studies. L. M. K. Boelter. COO-7, Aug. 1949. 173p.

The primary objectives of this investigation are to obtain heat-transfer and pressure drop data in the higher ranges of pressure, temperature, and velocity for water flowing in an electrically heated vertical tube and to attempt to evolve a technique for measuring average fluid densities across the tube at a given axial station. The ranges of parameters are: pressures to 4,000 or 4,500 psi, velocities to 50 ft/sec, temperatures (of water fluid) to 750°F; heat flux densities to 4×10^6 BTU/ft^2 hr; tube diameters 1/8 in. to 1/4 in., L/D = 100. The principal interest is in the ranges: pressures 1,000 to 2,000 psi; temperatures to 600°F; heat flux rates into the nucleate boiling region. Associated basic research on boiling and related phenomena are being concurrently pursued. Appropriate sections of this report describe the status of these studies. A large part of the work to date has been involved in obtaining information on which to base the design of test equipment and associated instrumentation, and the subsequent design, specification, and procurement or construction of the items. Chapter I is a general discussion relating the specific basic studies undertaken to the general objectives and outlining the problems as now envisioned, studies of which are essential to interpreting and validating the significance of the data to be obtained in the major test installation. Chapter II describes the work done with a preliminary test installation utilizing existing laboratory equipment to launch a study

and gain experience by which designs, plans, procurement, and operation of the major test installation could be accelerated and the instrumentation problems attacked. Other chapters are concerned with the determination of the electrical sensitivity of the heating tube, thermal conductivity of the heating tube, special instruments and devices, determination of air concentration in the circulating water, density measurements, preliminary concepts concerning the mechanism of heat transfer in forced convection local boiling, mechanism of bubble initiation and growth, visual and auxiliary studies, and design of main test installation.

1434 Method and Apparatus for Producing Radiographs. Seth H. Neddermeyer and Donald W. Kerst (to the Director of the Office of Scientific Research and Development, Office for Emergency Management). U. S. Patent 2,418,523, Apr. 8, 1947.

A method is described of obtaining a radiograph or shadowgraph of an object undergoing change, which is particularly applicable when the source of radiation (x-rays) is comparatively weak and pulsed in the time order of a microsecond or less, as is the case with x-radiation from the betatron. In this case ordinary photographic analysis is impossible, and instead the following scheme is proposed. Between the x-ray source and a camera are interposed the object under investigation, next to the source, and a multiple set of cloud-chambers, each of which has a pair of opposite walls one of which is partially opaque to x-rays, both of which are transparent to light. Upon initiation of an x-ray burst from the source, the shadow of the object, which is opaque to the transmission of x-rays, is projected upon the adjacent wall of each individual cloud-chamber, where thus a shadow image of the object is formed. This image acts as a source of photo-electrons, which then produce tracks in the cloud chambers that are photographed by the camera. Each individual chamber will respond in proportion to the number of photons contained in a unit cross section of the x-ray beam. Many cloud chambers are used simultaneously in order to get an image of greater density and of more clearly defined contrast than that obtainable from a single cloud chamber.

1435 Precision Multiple Internal Timer for X-ray Processing. H. E. Crooks. Atomic Energy Research Establishment Report No. AERE-Med/R-436, Dec. 1949. 4p.

In the processing of x-ray films for radiographic work, the clockwork timer which is in general use today has the following disadvantages: (1) re-setting is required for each film; (2) it indicates only the time of immersion in developer, yet development continues while the film is being drained and rinsed prior to fixation. The multiple precision 5-min interval timer described in this report does not require re-setting, and in addition the duration of the draining and rinsing stage can be standardized and included in the total development time. (auth)

1436 Radiography with Cobalt-60. Adair Morrison. Nucleonics 5, 19-32(1949) Dec.

Co^{60} may be used as a cheap substitute for radium in the industrial radiography of steel. A method is outlined for the measurement of the source strength and for the determination of satisfactory exposure conditions. Special techniques may be used if high sensitivity is required, or if it is necessary to analyze a sample of very irregular shape. Methods of handling and storing this isotope are discussed. In conclusion it is noted that Co^{60} has many practical advantages over radium for this application.

1437 Radioactive Tracers in Research and Industry. II. Biochemical and Industrial Uses. L. Tordai. Mfg. Chemist 20, 368-73(1949).

The isotope dilution method of analysis of organic compounds is described with reference to mixtures of NH_2-acids. Such problems as the utilization of P, Fe, glutathione, and vitamin-E have been examined by this method, which has been extended to the investigation of the effects of drugs, such as penicillin and benadryl, on the organism and production of suitable H_2O-insoluble iodo-compounds for addition to salt blocks for cattle. The part played by free or combined S in the vulcanization of rubber, the measurement of the thickness of thin sheets, the dissipation of static charges on moving belts and textile machinery, the efficiency of physical methods of separation, e.g., filtration and centrifuging, and the measurement of the homogeneity of mixtures by radioactive methods are also described. Application of tracers in purity control of industrial preparations, measurement of efficiency of distilling operations and the study of flow velocity in liquids and gases are also suggested.

1438 Calibrating Means for Pitot Venturi Tubes. Henry W. Stoll (to U. S. Atomic Energy Commission). U. S. Patent No. 2,441,042, May 4, 1948.

A calibrating means comprising an annular ring which may be mounted at various places on the outer surface of a venturi tube. By moving a ring, the turbulence at the outlet end of the tube may be varied, thus permitting adjustment of the flow characteristics of the tube to correspond to a given standard.

1439 Packless Valve. Jesse B. Thomas (to U. S. Atomic Energy Commission). U. S. Patent No. 2,442,625, June 1, 1948.

A packless valve having a hollow expansible streamlined plug of teardrop form enclosed in a housing having a shape similar to but larger than the plug member. The rear portion of the plug member is affixed with streamline supports to the valve housing with the front portion of the plug member being moveable in respect to the rear portion. The movement may be attained through a toggle mechanism or by the use of fluid pressure applied to a piston and cylinder arrangement on which the front of the member is mounted. Actuating means are mounted within the plug portion of the body and hence interference with the streamline flow of fluid through the valve is minimized.

1440 Pressure Measuring Device. William R. Perret (to U. S. Atomic Energy Commission). U. S. Patent No. 2,486,976, Nov. 1, 1949.

A pressure measuring device that utilizes the discovery that the current in the exterior circuit of a Phillips type pressure gage has a characteristic high frequency alternating current component which is directly proportional to the pressure of the medium gas and in addition is dependent upon its composition. Thus in a given gas system, the pressure may

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be directly measured by measuring this frequency characteristic, and in addition a vacuum system may be tested for leaks by probing the exterior of the system with a gas of a different composition than that within.

1441 Valve. Willard C. Hein and Leonard W. Winchester (to U. S. Atomic Energy Commission). U. S. Patent No. 2,465,018, Mar. 22, 1949.

A cam operated valve for use in severe services such as in vacuum systems. The entire valve mechanism is mounted in a flange which may be simply connected into a vacuum or fluid system.

MINERALOGY, METALLURGY AND CERAMICS

1442 Refractory. Arthur F. Johnson (to Reynolds Metals Company, Richmond, Va.). Canadian Patent 461,648, Dec. 6, 1949.

A refractory is described which consists of a vitrified composition of aluminum nitride in an amount varying from 15-50%, the balance comprising alumina and a compound of the group consisting of zirconia and silica.

1443 Bibliography on Powder Metallurgy with Emphasis on Porous Metals. Fred E. Croxton. AECD-2763, Apr. 2, 1948, decl. Dec. 19, 1949. 40p.

Chemical Abstracts covering the years of 1927 to 1947, Engineering Index for 1946, and Industrial Arts Index, were searched for references on powder metallurgy in the production of porous metals with particular emphasis being given to the pressing and sintering steps.

1444 Magnetic Properties of Alloys with Palladium Bases. Jules Wucher. Compt. rend. 229, 1309-10(1949) Dec. 14 (in French).

The paramagnetism of alloys with nickel bases has already been studied by other authors (Manders, Ann. Phys. 5, 167 (1936); Néel, ibid., 232(1936)). It has been found that the Curie constant varies linearly with the electronic concentration of the nickel. Since Pa has the same electronic configuration and the same atomic Curie constant as nickel, one may expect the alloys of Pa to behave in a similar manner. Various percentages of Cu, Ag, Au, Al, Sn, Pb, and Sb were alloyed with Pa and the Curie constants were measured. These constants were plotted against the concentration of the element in question, and the curves were found to be approximately linear over an appreciable range of concentrations.

1445 Physical Properties of Polonium. I. Melting Point, Electrical Resistance, Density, and Allotropy. Charles R. Maxwell. J. Chem. Phys. 17, 1288-1292 (1949) Dec.

Measurements on the electrical resistance, thermal coefficient of electrical resistance, melting point, and density of polonium are reported. An abrupt change in the electrical resistance near 100°C indicates that polonium exists in two allotropic forms. Observations which indicate that the temperature for crystal transformation is a function of the size and history of the specimen are reported. (auth)

1446 Physical Properties of Polonium. II. X-ray Studies and Crystal Structure. William H. Beamer and Charles R. Maxwell. J. Chem. Phys. 17, 1293-8 (1949) Dec.

Structures are proposed which account for the powder diffraction patterns obtained from samples of polonium containing various amounts of lead. Unusual temperature effects are recorded for α polonium. It is suggested that the Pb and Po are present in interpenetrating primitive cubic lattices which are indistinguishable because the atomic numbers are nearly the same. (auth)

1447 The Properties of Sand Cast Magnesium-Rare Earth Alloys. Thomas E. Leontis. J. Metals 7, 968-82(1949) Dec.

All the rare earth metals investigated enhance the strength, hardness, and creep resistance of magnesium at room and elevated temperatures. There are, however, marked differences among the metals in the degree to which they improved these properties. The results of this investigation have shown that considerably higher elevated temperature properties can be developed in magnesium-didymium and magnesium-cerium-free Mischmetal alloys than those exhibited by magnesium-Mischmetal alloys. At 400°F, for example, the properties of magnesium-didymium alloys are 20-50% higher than those of magnesium-Mischmetal alloys. Several tables, graphs, and photomicrographs are included.

1448 Surface Hardening of Ferrous Metals. Hermann I. Schlesinger and George W. Schaeffer (to U. S. Atomic Energy Commission). U. S. Patent No. 2,494,267, Jan. 10, 1950.

Surface hardening of ferrous metals, such as iron, steel, cobalt or nickel, is accomplished by subjecting the surface of the material, after thorough cleaning and deoxidation, to the action of gaseous diborane at a pressure of between about 3 mm of mercury to 50 mm of mercury, while maintaining the temperature of the surface to be treated in the range of 500-700°C. Boriding to a depth of about 5 μ produces a surface which is very abrasion resistant and quite corrosion resistant.

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1449 Elastic Constants and Sound Velocities. V. Torsional Vibrations of Coupled Cylinders. Myra F. Kilpatrick and John E. Kilpatrick. AECU-666, nd. 38p.

Equations have been derived to give the torsional vibrational frequencies of a system consisting of two identical cylinders joined axially by means of a third cylinder. Such a system corresponds satisfactorily to the experimental set-up frequently used to determine the modulus of rigidity of a sample. The relation of the frequency spectrum to the various parameters of the system is discussed in detail. Two sets of experimental frequency data are compared with the results of the theoretical equations. (auth)

1450 Correlation of Pulsed and D-C Electron Emission from an Oxide Cathode. R. B. Bien. M.I.T. Research Laboratory of Electronics Technical Report No. 73, June 29, 1949. 11p. (NP-1238.)

Under suitable temperature conditions, i.e., at 843°K and below, it was found that the temperature variation of pulsed and d-c thermionic emission is the same, and yields a single Richardson line. A variety of tubes were tested in which

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silicon was added as an adulteration in the oxide. Richardson plots showed that the work functions and log A vary linearly with the per cent of adulteration. At temperatures above 843°K, a rise and a decay in temperature-limited pulsed emissions were observed. The effects were explained by temperature rise of the cathode and possible surface electrolysis or positive ion bombardment. (auth)

1451 Electron Optical Observation of Magnetic Fields. L. Marton and S. H. Lachenbruch. J. Research Natl. Bur. Standards 43, 409-28(1949) Oct.

The electron optical analog of the "Schlieren" method may be used to explore electromagnetic fields where conventional methods fail. Furthermore, a related shadow method, especially suitable for the quantitative evaluation of such fields, has been found. The trajectory of an electron in a dipole field is analyzed and the properties of Schlieren patterns produced by two point poles is described. An experimental Schlieren pattern produced by a magnetized wire is interpreted. The related shadow method is then applied. It is seen that the experimental results agree with the theoretical conclusions and give reasonable values for the field strength.

1452 Measurement of Electron-Ion Recombination. Manfred A. Biondi and Sanborn C. Brown. Phys. Rev. 76, 1697-1700(1949) Dec. 1.

Microwave techniques are applied to the measurement of the recombination between electrons and positive ions. The measured recombination coefficients for monatomic gases range from 1.7×10^{-6} cc/ion-sec for helium to 3×10^{-7} cc/ion-sec for argon. The recombination coefficients for diatomic gases range from 2.5×10^{-6} cc/ion-sec for hydrogen to 2.8×10^{-7} cc/ion-sec for oxygen. At electron temperatures of 300°K, the recombination is found to be independent of pressure for the monatomic gases. A pressure dependence is observed in diatomic gases, the recombination increasing with increasing pressure in nitrogen and oxygen.

1453 On the Secondary Electronic Emission Produced by Negative Ions. V. M. Dukel'skiĭ and E. Ya. Zandberg. Zhur. Eksptl. i Teoret. Fiz. 19, 731-8(1949) (in Russian).

Comparative measurements were made of the coefficients of the secondary-electron emission of a platinum target under the action of ions I^- and I^+ in the energy range from 300-1,040 ev, and of ions Na^- and Na^+ in the range 290-2,200 ev. In both cases the coefficient of the secondary emission is considerably higher for negative ions than for positive ones. This is explained by assuming that a certain fraction of the observed secondary electrons is generated through the destruction of the negative ions themselves at the surface of the target.

1454 Repulsive Interaction Potentials at Small Interaction Distances: He-He and H-H_2 Systems. I. Amdur. J. Chem. Phys. 17, 844-5(1949) Sept. (Letter to the editor).

The application of Kells' method (J. Chem. Phys. 16, 1174(1948)) to the experimental results for He scattered in He yields the following potential, valid in the range 0.52-1.02 A (accurate to within about 3%):

$$V(r) = 3.14\exp(-4.21\ r^{1/2}) \times 10^{-10}\ \text{erg}$$

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The results contained in this equation are compared with the theoretical calculations of Slater and Margeneau. On the basis of the comparison the following relationship is proposed for the repulsive potential at all distances greater than 0.52 A:

$$V(r) = [7.70\exp(-4.60r) - 5.60\exp(-5.33r) - 0.68\exp(-4.50r^2)] \times 10^{-10}\ \text{erg}$$

For the case of high speed hydrogen atoms scattered in room temperature hydrogen molecules, it was not possible to fit the experimental results with a single potential function of the form $V(r) = K/r^n$. However, by means of another method, the following result was obtained for the interaction potential between a hydrogen atom and a hydrogen molecule:

$$V(r) = [0.567\exp(-24.9r^2) + 0.215r\ \exp(-2.40r^2)] \times 10^{-10}\ \text{erg}$$

for separation distances in the range 0.27-0.68 A.

1455 Thermionic Emission from Oxide Cathodes: Retarding and Accelerating Fields. C. S. Hung. M.I.T. Research Laboratory of Electronics Technical Report No. 131, July 20, 1949. 17p. (NP-1237.)

An experimental investigation is presented of the thermionic emission from oxide-coated (BaO and SrO) cathodes in which the applied voltage range extends from the retarding potential region through zero field and up to an average accelerating field of 50,000 v/cm. The retarding potential range yields information concerning the energy distribution of the electrons emitted, and indicates an excellent agreement between theory and experiment for high retarding fields. Near zero field, cathode inhomogeneity or patch effect may be responsible for the deviations found. Consideration is given to the influence of a possible reflection effect, but theoretical calculation indicates that with the large area cathode used, the simultaneous reflection at the emitter and the collector surfaces so alters the observed current voltage relationship, that the existence or nonexistence of a reflection effect cannot be determined by the experiment. Results shown in the accelerating field region up to 50,000 v/cm are accounted for on the bases of two assumptions: patch effect for small accelerating fields and the intensification of the field at sharp points expected in view of the inherent roughness of the cathodes studied. The deviation of the experiments results from those predicted by the Schottky mirror image theory (Ann. der Phys. 44, 1011(1914)) is explained over the whole range of observation by these two assumptions. 12 references. (auth)

1456 Review of Work on Artificially Produced Mesons. Hugh Bradner. UCRL-486, Oct. 19, 1949. 118p.

It is the purpose of this paper to assemble the best values available to date on meson production by artificial means and on meson properties. Details of experimental investigations performed with the α-particle beam of the Berkeley cyclotron, February 1948 to February 1949, and with the proton beam of the cyclotron, February to July, 1949, are given. A short account is given of the results thus far obtained with the 335-Mev Berkeley synchrotron. A summary of present concepts of meson properties is also given. Bibliography included.

1457 Absorption in Graphite and Altitude Effect of Particles Generating Pulses in the Ionization Chamber

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at 3,860 and 4,700 m. G. Guro, V. Nikolaev, L. Razorenov, and I. Chuvilo. Doklady Akad. Nauk S.S.S.R. 67, 623-6(1949)(in Russian).

Skobel'tsyn (Doklady Akad. Nauk S.S.S.R. 44, No. 5 (1944)) has pointed out that pulses in small ionization chambers, filled to moderate pressures, are due mainly to heavy particles or to nuclear disintegrations in the chamber's walls and in the filling gas. In the present paper, experiments are described, carried out at 3,860 and 4,700 m altitude with a spherical chamber of 24 cm diameter, filled with argon to 4 atm; the brass walls were 1.5 mm thick. At 4,700 m measurements were taken with and without a 64 g/cm² graphite filter compensating for the air layer between 4,700 and 3,860 m. The presence of showers was accounted for by seven counters. The results showed that at 4,700 m the filter did not bring the number of pulses down to the value observed at the lower altitude, and that the difference between pulse numbers counted with and without the filters was small. The latter phenomenon must be due to the so-called density effect, produced in the chamber by the cumulative action of secondary particles. The former phenomenon, although due to a small extent to density effect, is chiefly traceable to the disintegration of the generating component in the graphite.

1458 Angular Distribution of Mesons Produced in Photographic Emulsions. A. Gamba and L. A. Radicati. Nuovo Cimento 6, 374-8(1949) Sept. (in Italian).

An examination of photoemulsion recordings of nuclear disintegrations (on plates obtained in the laboratory of Powell and Occhialini) revealed the existence of two classes of tracks issued from a common center: (1) tracks covering an angle of 50 deg., which are due to π mesons, and (2) isotropically distributed tracks produced by protons and other nuclei. Class (1) is interpreted as a multiple meson production, isotropic in the coordinate system of the common center of gravity of the colliding nucleons. Class (2) corresponds to a later process of nuclear evaporation in a system at rest in relation to earth. The energy of the primary particle responsible for the observed phenomena must be $\sim 10^4$-10^5 Mev. The meson momentum is $\cong mc$. This is in agreement with Wataghin's opinion (Phys. Rev. 73, 975(1948)) that the number of mesons in a multiple production is the greatest possible for a given energy.

1459 Auger Showers and the Electron Component of the Cosmic Radiation. P. Budini. Nuovo Cimento 6, 402-4(1949) (Letter to the editor, in Italian).

Certain assumptions on the mechanism of formation of the various components of the cosmic radiation lead to the conclusion that, below a certain altitude above sea level, the electron component is in a state of equilibrium with the generating component. This relationship explains the known independence of the ratio soft/penetrating from the altitude, as observed in Auger showers. Up to about 6,000 m, the calculated increase of the frequencies of Auger showers with the altitude agrees with the experimental findings; beyond that altitude, the theoretical value is higher than the experimental one.

1460 Cosmic Radiation from the Sun. Johannes Zirkler. Z. Naturforsch. 4a, 394(1949) Aug. (Brief note, in German).

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The author points out that observed temporary changes in the cosmic radiation as found by himself (Z. Geophys. 18, 127(1943)) and by Ehmert (Z. Naturforsch. 3a, 264 (1948)) can be connected with a magnetic storm in 1941.

1461 Density Spectrum of Penetrating Particles in Extensive Atmospheric Showers of Cosmic Rays. G. T. Zatsepin, I. L. Rozental, S. A. Slavatinskiĭ, G. B. Khristiansen, and L. A. Shuvaev. Doklady Akad. Nauk S.S.S.R. 69, 341-3(1949)(in Russian).

It has been shown (Alekseev et al, Doklady Akad. Nauk S.S.S.R. 63, 375(1948)) that penetrating particles observed in extensive atmospheric showers are not generated in the recording instruments, but belong to the showers themselves in the air. In the present work the density spectrum of these penetrating particles was determined by the usual methods of varying counter areas and varying numbers of counter groups. For the density spectrum $N(>\rho) = C\rho^{-\kappa}$ it was found $\kappa = 1.47 \pm 0.07$ by the first method, and $\kappa = 1.60 \pm 0.15$ by the second. For the electron component in showers of the same mean energy, the best value for κ_e is 1.53 ± 0.04. Therefore, the ratio penetrating-particles/electrons does not change with the shower's energy. It is shown that this result confirms Zatsepin's idea (Doklady Akad. Nauk S.S.S.R. 67, No. 6, (1949)) on the origin of atmospheric showers: the colliding primary proton cedes the greater part of its energy to a large cascade of particles multiplying by nuclear disintegration and generating penetrating particles; only a small fraction of the proton's energy goes to the formation of the electron-photon component. Cocconi et al (Phys. Rev. 75, decreases with the shower's density at the rate $\rho^{-0.13}$; the present authors give an explanation of this discrepancy with their own result.

1462 Directed Phenomena and Latitude Effects Produced by Cosmic Nucleons in Sensitive Emulsions. Charles Beets, Max Morand, and Léon Winand. Compt. rend. 229, 1227-8(1949) Dec. 5 (in French).

The authors have studied the stars and isolated tracks produced in sensitive emulsions (Ilford G_5 and C_3 + B), exposed in a vertical east-west position in the Belgian Congo. An east-west dissymetry for isolated tracks was noted and measured. The density of stars with more than two branches was measured, and the results are compared with similar measurements made on plates exposed on the Jungfraujoch. This comparison indicates that there is a 2.4/1 reduction in the intensity of the nuclear component at this low latitude because of the magnetic cut-off effect of the earth's magnetic field.

1463 Distribution of Stars of Various Number of Prongs, Produced by Cosmic Rays in Photographic Plates at 29,000 m Altitude. M. M. Addario and S. Tamburino. Nuovo Cimento 6, 405-7(1949) Sept. (Letter to the editor, in Italian). (See also NSA 3-1920.)

The distribution of stars according to the number of prongs was determined, using plates exposed to cosmic rays at 29,000 m altitude. The results were compared with these obtained by Bernardini et al at 3,500 m (Phys. Rev. 74, 845(1948)). It was found that the radiation responsible for the production of many-pronged stars is more intensely absorbed in air than that producing stars with a small num-

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ber of prongs. This is in agreement with the observations of Gardner and Peterson (Phys. Rev. 75, 364(1949)) on stars generated by deuterons from the cyclotron: the number of prongs increases with the deuteron energy. Another regularity found by the present authors is that the cross section for star generation increases with the energy of the corresponding primary.

1464 Generation of Protons and Varitrons by the Neutral Component of the Cosmic Radiation. A. I. Alikhanyan, M. I. Daĭon, and V. M. Kharitonov. Zhur. Eksptl. i Teoret. Fiz. 19, 739-48(1949)(in Russian).

Charged particles, generated in lead by the neutral component of the cosmic radiation, were observed at 3250 m altitude. By means of magnetic analysis, the generated particles were identified as protons and varitrons. It is surmised that the protons are produced as a result of an exchange of charge, taking place when a fast neutron interacts with a nucleus; this process of charge exchange is probably accompanied by the generation of varitrons.

1465 The Heavy Nuclei of the Primary Cosmic Radiation. H. L. Bradt and B. Peters. Phys. Rev. 77, 54-70 (1950) Jan. 1. (See also NSA 2-446, 3-735, and 3-1230.)

The flux of primary cosmic-ray nuclei, heavier than protons, was determined at geomagnetic latitudes $\lambda = 55$ deg. and $\lambda = 30$ deg. N. It is shown that at $\lambda = 30$ deg. at least one-half of the incident nucleons and a significant fraction of the incident cosmic-ray energy is due to the heavy component. The distribution of atomic numbers among the primaries was determined at both latitudes; the relative magnitude of the fluxes of the nuclei H:He:C,N,O: (nuclei of charge $Z > 10$) is given approximately by the ratio 4000:1000:35:10. The possible significance of these results for the theories on the origin of cosmic rays is discussed. A preliminary report of this study was given under the title The Flux of Heavy Nuclei of the Primary Cosmic Radiation at Geomagnetic Latitudes $\lambda = 55$ deg. and $\lambda = 30$ deg., Phys. Rev. 76, 156(1949).

1466 Low Energy Mesons in the Atmosphere. Matthew Sands. Phys. Rev. 77, 180-93(1950) Jan. 15.

The dependence on altitude of the intensity of slow mesons, mesons with ranges less than 100 g cm^{-2}, has been measured by the method of delayed coincidences for atmospheric depths down to 250 g cm^{-2}. The intensity at this depth is 30 times that at sea level, and the variation with the depth x is approximately as $\exp(-x/\alpha)$ where α is 220 g cm^{-2}. The differential range spectrum of mesons at sea level has been measured by the same method for ranges between 10 g cm^{-2} and 200 g cm^{-2}. The spectrum is nearly flat in this interval, the value at the lower limit being 0.9 of that at the upper limit. The data which are available in the literature have been examined to obtain the differential range spectrum of mesons whose ranges are greater than 100 g cm^{-2} and less than 3×10^4 g cm^{-2}, and to obtain the variation with altitude of the intensity of fast mesons—mesons with ranges greater than 100 g cm^{-2}. The experimental results can be explained with the assumption that the number of mesons produced in the depth interval dx at the depth x with ranges in dR at R varies as $G(R)dR \exp(-x/L)dx$. Using 125 g cm^{-2} for L we have arrived at a production spectrum G(R) which is compatible with the experiment data. In the computations, the exact energy-range relation and an empirical atmospheric pressure-altitude relation were used. The spectrum obtained can be represented approximately by $G(R) = (R + \alpha)^{2.9}$, where $\alpha = 210$ g cm^{-2}. The exact spectrum is 40% lower for ranges of 100 g cm^{-2} and less. The observed spectra which result from the derived production spectrum have been computed for several altitudes.

1467 On the Decay of Cosmic-Ray Particles Generating Nuclear Disintegrations. G. E. Belovitskiĭ, N. V. Maslennikova, V. F. Smirnov, and L. V. Sukhov. Doklady Akad. Nauk S.S.S.R. 69, 321-4(1949)(in Russian).

The complex composition of the star-producing component of cosmic radiation being now recognized, the authors show that unstable particles enter as an important part into that composition. Stars, isolated tracks, and stopped mesons were counted in photo-emulsions exposed at altitudes 4,700, 3,860, and 2,200 m, with and without C, Al, and SiO_2 absorbers equivalent to air layers between the three altitudes; comparisons were made between the results obtained in air and in dense matter. A disintegration effect in air was observed, responsible for the formation of stars with the prong number two and three; the mean half-lifetime of the generating particles is 5×10^{-6} to 10^{-5} sec. They are probably mesons. From the findings of Hasen (Phys. Rev. 65, 67(1944)), correlating comparatively small-energy stars with nonionizing particles, it is further possible to presume that the particles in question are neutral mesons. Recently, Lattimore et al (Phil. Mag. 40, 394(1949)), searching for unstable particles by a similar method, obtained negative results; this was probably due to less sensitive emulsions and to photo-regressions.

1468 On the Disintegration Products of the 2.2-μ sec Meson. E. P. Hincks and B. Pontecorvo. Phys. Rev. 77, 102-20(1950) Jan. 1. (See also NSA 1-1421.)

An investigation of the penetration through absorbers of various elements by the charged particles that result from the 2.2-μsec meson decay is reported. Mesons and decay particles are detected by an arrangement of Geiger-Mueller counter trays, and delayed coincidence techniques are used to select the desired events. The absorption measurements exhibit two components in the decay radiation, one of which is much more penetrating than the other. In lead, for example, the "soft component" is essentially absorbed by about 20 g/cm^2, while the "hard component" is easily detected after 38 g/cm^2. A different arrangement of counters is used to show that the "hard component" is due to a neutral radiation which accompanies the charged decay particles. This result, and measurements of the intensities of the "hard component" with lead and carbon absorbers, provide strong evidence that the neutral radiation is, in fact, bremsstrahlung from the charged particles which constitute the "soft component." The bremsstrahlung intensities, together with the form of the absorption curve, are shown to lead to the following conclusions: (1) the charged decay particles are electrons (i.e., they have a mass less than two electron masses); (2) a considerable number of electrons are emitted with energies greater than 25 Mev; (3) the average energy of the electrons is greater than 25 Mev; (4) there is no evidence for electrons of energy much greater than 50 Mev. The

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support which these results lend to the currently favored ideas on the meson decay process is discussed.

1469 On the Empirical Law for the Angular Distribution of the Hard Cosmic Ray Component in the Lower Atmosphere. André Fréon and Tsai-Chu. Compt. rend. 229, 753-5(1949) Oct. 17. (in French).

The distribution law $I(\theta,P,h) = I\nu(P,h) \cos\lambda\theta$ is assumed for the angular distribution of the hard cosmic ray component, λ being a parameter whose value is to be determined empirically, θ the angle between the direction in which measurements are taken and the zenith, $I\nu$ the vertical intensity, $P = pc/M_oC^2$ the minimum momentum of the observed particles (a function of the thickness of absorbing material used), and h the pressure in meters of water. The object of the experiment was to determine λ. To this end, a previous set of measurements at 8.07 m of water were corrected for pressure effects and a new set of measurements was taken at Paris at 10.24 m. In conclusion the author gives as empirical law for λ,

$$\lambda(h,P) = 4.02 + 0.016h^2 - 0.347h - 0.0373P$$

accurate to within 1% for $\theta < 65$ deg., h between 10.33 and 6.8 m of water. Measurements of $I\nu$ agree with data given by other authors.

1470 On the Mass of Charged Particles of the Cosmic Radiation. C. Franzinetti. Phil. Mag. 41, 86-105 (1950) Jan.

The mass of charged particles, produced by cosmic radiation at an altitude of 11,000 ft, and brought to rest in photographic emulsions, has been determined by "magnetic-deflection" experiments. The method is applicable to particles, of any type, of which the lifetime is greater than 10^{-10} sec. The results show that at an altitude of 11,000 ft the particles are composed of different types in the following proportions:

μ^+-particles, 8.5 ± 1.5%; μ^--particles, 8 ± 2.4%;

π^+-particles, 4.0 ± 1.0%; π^--particles, 5.4 ± 2.0%;

Protons, 48 ± 4%; deuterons, 16 ± 2%; more massive positive particles, 11 ± 2%.

The observations on the tracks of 360 particles give no evidence for the existence of other kinds of particles sufficiently stable to be detected by this method; and they show that if such particles exist, they are very rare.

1471 On the Nature of the π-Meson. B. Ferretti and S. Gallone. Phys. Rev. 77, 153-4(1950) Jan. 1 (Letter to the editor).

The authors assume that the π meson has spin zero and discuss the possibility of distinguishing experimentally the scalar from the pseudoscalar meson. It is pointed out that these two particles should behave very differently with respect to absorption in deuterium, but such an experiment is ruled out on practical grounds. However, it is to be expected that the ratio of the scattering cross sections for low energy mesons in hydrogen and deuterium should be very different for vector and scalar particles. This ratio is calculated for three energies of both types of mesons, and the authors conclude that a decisive experiment could be carried out with a slight improvement in present methods.

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1472 On the Nuclear Evaporation in Cosmic Rays and the Absorption of the Nucleonic Component. I. G. Bernardini, G. Cortini, and A. Manfredini. Phys. Rev. 76, 1792-7(1949) Dec. 15. (See also NSA 1-1401 and 2-740.)

The absorption of the star-producing radiation was studied with the sensitive emulsion method. Absorption experiments were carried out at the Laboratorio della Testa Grigia using various thicknesses of Pb and Al absorbers, and plates were sent up in balloons to study absorption in air. It is concluded that most of the nuclear evaporations are caused by the nucleonic cosmic ray component. Previous work on the absorption of the hard-shower producing component is also discussed. On the basis of the results of such studies it is estimated that each primary proton, in traversing the atmosphere, gives rise on the average to more than 10 secondary nucleons having energies of the order of magnitude of some hundreds of Mev.

1473 The Relationship between the Electron and Photon Components. E. Clementel and L. Fabbrichesi. Nuovo cimento 6, 399-401(1949)(Letter to the editor, in Italian).

In a previous paper (Nuovo cimento 5, 78(1948)) the authors have calculated the integral spectrum of the electron component in air and lead, by extending the theory of cosmic radiation showers toward the low energies. By the same method a calculation of the integral spectrum of the photon component was made, the final purpose being the determination of the relationship between the two components. However, the two integral spectra are not confronted directly; the Laplace transform is used for the representation of both differential and integral spectra.

1474 Some Statistical Relationships Concerning Extensive Atmospheric Showers. I. Ya. Barit and M. I. Podgoretskiĭ. Doklady Akad. Nauk S.S.S.R. 68, 23-6 (1949)(in Russian).

This theoretical inquiry is connected with observations by Razorenov et al (Zhur. Eksptl. i Theoret. Fiz. 19, 283 (1949); Doklady Akad. Nauk S.S.S.R. 60, 1531(1948)) on correlated pulses produced by extensive showers in two or more ionization chambers. Relationships are derived that must be true only if the showers are composed of relativistic particles whose spacial distribution follows Poisson's law; this condition is shown to correspond to the cascade mechanism of the showers. The relationships obtained can serve as tools for testing assumptions on the nature of observed phenomena. It can be verified, for instance, if the observed inequality of pulses in two chambers is due exclusively to the presence of strongly ionizing particles. One of the statistical problems that can be solved by the proposed relationships is the following: given the value of a pulse in one of the two ionization chambers used, what is the distribution law of possible values of pulses in the other chamber ?

1475 The Star-generating Component in the Penetrating Radiation. B. Ferretti. Nuovo cimento 6, 379-89 (1949) Sept. (in Italian).

A model is worked out that permits a phenomenological study of the star-producing component in the penetrating cosmic radiation. The discussion is devoted chiefly to that

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part of the said component which is responsible for the majority of nuclear evaporations and of minor explosions whose energy is less than a Bev. The results obtained are confronted with the experimental data.

1476 A Study of the Absorption of Primary Cosmic Rays in the Stratosphere. K. I. Alekseeva and S. N. Vernov. Doklady Akad. Nauk S.S.S.R. 69, 317-19 (1949)(in Russian).

In Doklady Akad. Nauk S.S.S.R. 62, No. 2(1948) the authors have described showers generated in the stratosphere by penetrating particles in 4 cm Pb. Since it has been found that the effect was partly due to electrons, the experiments were repeated with 8 cm Pb. The results show that penetrating particles are absorbed in air exponentially, the absorption coefficient being 1/120 cm^2/g up to 20 km altitude, and 1/60 cm^2/g beyond that level (the highest altitude reached was 24.5 km). It was concluded that the showers were generated chiefly by primary particles spending in this act almost the totality of their energy. The absorption in air and in lead follows approximately the $A^{2/3}$ law.

1477 On the Exchange of Phosphorus Isotopes between H_3PO_2, H_3PO_3 and H_3PO_4. V. D. Ionin, A. F. Lukovnikov, M. B. Neĭman, and An. N. Nesmeyanov. Doklady Akad. Nauk S.S.S.R. 67, 463-6(1949)(in Russian).

Many attempts at a separation of isotopes by way of isotope exchanges in chemical reactions have failed, because of a seeming impossibility of such exchanges in certain cases. It has been shown, however, (Zaborenko et al, Doklady Akad. Nauk S.S.S.R. 64, 541(1949)) that, by raising the temperature of the reaction, positive results are obtained in the case $KI^* + KIO_3$ (in aqueous solution). In the present work, attempts were made to reach analogous results in the cases $NaH_2P^*O_4 + NaH_2PO_2$ and $H_3P^*O_4 + H_3PO_3$. Sealed ampoules containing mixtures of aqueous solutions of these substances were placed in steel bombs and heated for many hours at temperatures from 100-380°C; after the separation of the reaction products, the latter's activity was measured with a counter. None of the results showed any measurable isotope exchanges.

1478 Results of Temperature Investigations. VIII. Rectification of $H_2 - HD - D_2$ Mixtures to Obtain Deuterium Hydride, Deuterium, and Heavy Water. Klaus Clusius and Kurt Starke. Z. Naturforsch. 4a, 549-59(1949) Oct. (in German).

A procedure is described of obtaining heavy water by fractional distillation. It is pointed out in detail how this procedure can be adapted to economical production of D_2O on a large scale. It is shown by the authors that the amount of energy necessary to obtain 1 g of D_2O by the method proposed is 4.8 kw-hr, compared to the 120-150 kw-hr, when electrolysis is used.

1479 A Szilard-Chalmers Effect in Natural α Disintegrations. M. Haissinsky and M. Cottin. J. chim. phys. 45, 270-2(1948) Nov.-Dec. (in French).

The Szilard-Chalmers effect resulting from the reaction $UI(U^{238}) \rightarrow UX1(Th^{234})$ was investigated. The authors developed a chemical method adapted from a technique of Starke (Naturwissenschaften 30, 577(1942)) to separate UX1 which was formed by α emission. The experimental accuracy is insufficient to indicate the influence of the degree of dilution of the chemical solutions used on the efficiency of separation, but it is shown that there is a marked decrease in efficiency when solid compounds are used, which is consistent with a hypothesis of Franck and Rabinowitsch (Trans. Faraday Soc. 30, 120(1934)).

1480 A Mass Spectrometer for Routine Hydrogen Isotope Analyses, Supplement No. 1. Alfred O. C. Nier, Charles M. Stevens, and Brice Rustad. AECD-2767, Mar. 17, 1943, decl. Jan. 3, 1950. 21p.

A number of improvements have been made to the special hydrogen spectrometers, making the instrument easier to operate and also more reliable and less critical in adjustment. These improvements are discussed as follows: (a) the construction of the ion source has been simplified, making the adjustment less critical and giving a somewhat higher intensity of ions for the same pressure and electron current; (b) the electron emission has been raised from 1 to 5 ma, increasing the ion currents by a factor of 5 and consequently increasing the sensitivity and simplifying the maintenance problem; (c) increase in the ion currents has necessitated an increase in the range of the feedback amplifier used for measuring the hydrogen ions. The increase in sensitivity also makes possible the automatic recording of abundance ratios.

1481 Quota Sampling and Importance Functions in Stochastic Solution of Particle Problems. G. Goertzel. AECD-2793, Nov. 7, 1949, decl. Jan. 25, 1950. 13p.

This report is one of a series on shielding and represents part of the work of a summer group working principally at Oak Ridge National Laboratory. A general stochastic problem is defined, and a quota sampling method for simplifying the solution of such a problem is outlined. An importance function, $Q(\alpha)$, is defined such that if it is known and can be used in the quota sampling, the solution of the stochastic problem is greatly greatly reduced in difficulty. Thus any function, $q(\alpha)$, used in quota sampling should be selected to represent $Q(\alpha)$ as closely as possible. The method is shown for setting up a pair of problems, such that the solution of each is the importance function for solving the other. Thus $Q(\alpha)$ may be estimated stochastically.

1482 Theory of Critical Fluctuations. M. J. Klein and L. Tisza. Phys. Rev. 76, 1861-8(1949) Dec. 15.

A macroscopic system is subdivided into cells of identical size and shape arranged in a regular spatial array. The method of canonical ensembles would consider one of the cells, schematizing the rest into a "reservoir." The present "cellular method" treats the cells on an equal footing and is appropriate to deal with the fluctuations near the critical point for which the standard theory yields infinite results: Earlier theories dealing with the same problem appear as special cases of the present treatment. In particular, the critical points are defined generally enough to include the so-called λ points in solids. The macroscopic system is invariant under the group of translations which displaces one cell into another. The macroscopic quantities (e.g., the thermodynamic parameters) are invariants of this group.

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1483 Scintillation Type Alpha Particle Detector. A. S. Golden, E. R. Rohrer, and R. L. Macklin. AECU-633(K-505), Aug. 10, 1949. 10p.

A portable scintillation detector for α survey work is described, which utilizes a ZnS phosphor, a photomultiplier tube, and a rate meter. The instrument can detect as few as 16 α counts (32 disintegrations) per minute because of the virtual elimination of spurious background. The upper limit of 50,000 counts per minute is not inherent and can be raised by appropriate circuit changes. The instrument is stable and is unaffected by most atmospheric conditions other than strong sunlight. Gamma radiation up to 14,000 mr/hr gives no detectable response on this α meter. The probe is the size of a GT type radio tube with a shield, allowing access to relatively small spaces. The sensitive area is about 1 in. by ½ in. when a 931-A photomultiplier tube is used. (auth)

1484 A Method of Estimation of Beta Activities from Bremsstrahlung Measurements in an Ionization Chamber. P. C. Tompkins, Leon Wish, and W. T. Burnett, Jr. AECU-643(ORNL-276), Sept. 12, 1949. 26p.

The use of β emitters at activity levels greater than 1 mc has made it desirable to develop procedures that can be used to quantitatively determine such activities directly on the original material. A procedure for the purpose has been successfully developed by the authors, utilizing a high-pressure ionization chamber which is normally used for γ-radiation measurements. The procedure depends on the fact that, when energetic β particles are absorbed by matter, a part of the energy is lost through the production of Bremsstrahlung (secondary electromagnetic radiation). Since the chamber and container walls are thick enough to absorb all of the β particles, the ion current produced in the chamber by the Bremsstrahlung is quantitatively related to the activity of the sample. This paper describes studies which have been made to identify the important variables which must be controlled for quantitative Bremsstrahlung measurements. The major limitations of the Bremsstrahlung method of measuring radioactivities are: (1) an extreme sensitivity to the presence of a γ-emitting impurity; (2) relatively high activities are required; (3) variations arising from an inhomogeneous composition of the medium and its immediate environs. The wide range, stability, and linearity of response of the instrument make possible the accurate determination of the half-life of many radionuclides. Also, one may determine directly β activities in many solutions and solids, particularly those which are highly hydrated, which could not otherwise be measured without extensive processing. A trace of a γ-emitting impurity, not detectable on the Geiger-Mueller β counter, can be picked up with the ion chamber so that it should be possible to develop rapid analytical procedures for the determination of radiation purity. The method does not appear suitable for extensive application to chemical processing problems involving high salt concentrations, precipitates and suspensions, tracer studies at low activity levels, or the accurate measurement of weak β emitters such as C^{14} and S^{35} below the 100-mc level. 11 references.

1485 Scintillation Studies on Potassium Iodide; the Decay Scheme of Potassium 40. M. Freedman, J. May, and B. Smaller. AECU-657(UAC-173), nd. 17p.

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Preliminary results of an investigation into the detailed nature of the mechanism of emission phenomena associated with ionic crystal lattices and with imbedded impurities are presented. Recent developments in photomultiplier tube design, permitting the detection of single photons, have allowed the emission process to be isolated. Thus the phenomenon of radiation from crystal structure can be related directly to photon emission theory and to the quantum process associated with trapped electrons. For the present investigations of scintillation counter applications, crystals of potassium iodide with various concentrations of thallium impurity were used. The radiation used to produce the glow phenomenon was either γ radiation from Tl^{208} or the radiations from K^{40} naturally present in the crystals. The decay spectra of K^{40} were compared with the known β-spectrum of Cs^{137}, and a decay scheme for K^{40} was postulated.

1486 A Proportional Ionization Counter. J. W. Kennedy. BNL-31, Dec. 1, 1949. 7p.

Proportional counters, in which the current in a primary burst of ionization is increased many fold by gas amplification, have long been familiar instruments for the detection and measurement of nuclear radiations. It seems quite possible that gas amplification might be just as useful in an ionization chamber connected to a d-c amplifier. The theory involved in the choice of gas, voltage gradient, wire size, and pressure is discussed. Some performance tests were made on 2 different experimental chambers using Argon with and without alcohol vapor, and the data obtained is discussed. Suggestions for future development are made, and it is anticipated that proportional chambers could be made available at about a third of the cost of an equivalent ionization chamber.

1487 Feasibility Study of an Alpha and Beta-Gamma Proportional Counter; Development Progress Report. General Electric Company Electronics Laboratory. M-4455, Nov. 24, 1949. 3p.

The results and status of the following studies are discussed briefly: investigation of gas flow chambers (argon and argon + CO_2) as compared to air chambers; flux plots of proportional counter cross sections; study of two pulse transformers as impedance matchers for proportional counters; preliminary design of a flat plate chamber. Future work is discussed.

1488 Portable Alpha-Beta-Gamma Survey Meter. Marshall E. Kulberg. Sylvania Electric Products. M-4462, Oct. 6, 1949. 10p.

The general description and design considerations for α-survey meters for the detection and measurement of sources of α-emitting materials usually on flat surfaces are presented. The detector unit is a thin-window-ionization chamber. It is expected that this instrument will be used mainly in laboratories dealing with radioactive materials for the detection of spills of alpha emitting materials. However, it may be used at times as a monitor in fields of radiation outside the laboratory and may be subject to rough usage. The electrical circuit has been settled and the mechanical design is in an advanced stage, awaiting completion and approval of the prototype before production of the final designs and drawings.

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1489 Palladium Film Fast Neutron Detector. Ben R. Gossick. NEPA-1228, Dec. 8, 1949. 6p.

Preliminary information has been obtained on resistance variations of a palladium film fired on a ceramic core, due to recoil-proton bombardment. In view of the large magnitude of resistance changes, it is proposed here that this resistor might be employed to measure the energy absorbed per gram of tissue as a result of a fast neutron flux. It seems rather certain that the effect is produced by hydrogen occluded in the palladium. The resistors which have been exposed thus far were manufactured by Continental Carbon, Inc. Resistors with unprotected palladium films were also obtained for pile neutron exposure and comparison with resistors having vitreous enamel and paint over the palladium. Jackets of paraffin, polystyrene, graphite, cadmium, and aluminum were used during some of the exposures.

1490 The Absolute Energy Yield in Fluorescent Materials Excited by α Particles, γ Quanta and Soft X-Rays. Immanuel Broser, Hartmut Kallmann, and Ursula Maria Martius. Z. Naturforsch. 4a, 204-17(1949) June (in German).

The absolute energy yield was measured for a number of fluorescent materials excited by α particles, γ quanta and soft x-rays. The measuring instrument for the fluorescence radiation was a sensitive secondary electron multiplier, whose spectral sensitivity was determined by means of a thermoelement. The energy of the α and γ radiation absorbed in the fluorescent materials was essentially determined by new methods, involving the fluorescent materials themselves, while the calibration of the x-rays was done with an ordinary ionization chamber. The results indicate that the absolute yields, which do not differ much after excitation with short wave light, differ here considerably for different fluorescent materials, and depend essentially on the kind of excitation. After excitation with α particles, fluorescent materials of the type ZnS have the greatest yields ($\sim 25\%$), while organic materials convert only a small fraction of the α energy into light. For excitation with γ rays, the differences are smaller, all the yields being in the neighborhood of 10%. For soft x-rays the yields are between those for α and γ radiation. An attempt is made at a theoretical explanation of the differences in yield, on the basis of assumptions about the mechanism of excitation.

1491 Air Proportional Counter. John A. Simpson, Jr. (to U. S. Atomic Energy Commission). U. S. Patent Application Ser. No. 719,525.

A multiple wire counter utilizing air at atmospheric pressure as the ionizing medium and having a window of a nylon sheet of less than 0.5 mil thickness coated with graphite. The window is permeable to alpha particles so that the counter is well adapted to surveying sources of alpha radiation.

1492 Determination of the Relation between the Effective Cross Sections of Boron and of Uranium by the Photographic Method. Ch. Haenny, P. Lerch and O. Rochat. Helv. Phys. Acta 22, 609-11(1949) Dec. 1 (in French).

Ilford C_2 + B, 100 μ, and Ilford Dl, 50 μ plates loaded with uranium were irradiated, with and without a Cd screen, by a Ra-Be source of 50 mc. The solution used to load the plates with uranium is described in detail. Special provisions were made to eliminate α tracks which might be confused with fission tracks, and to erase the haze produced by γ rays. The number of tracks on the various plates is tabulated, and, assuming a cross section for boron of 707 barns at 2,200 m/sec, the uranium cross section turns out to be 580 ± 120 barns. In conclusion the author discusses the effects of underdevelopment of the plates. This appears to be an effective method of descriminating in favor of highly ionizing particles.

1493 Effect of Light on a Diamond Conduction Counter. R. K. Willardson and G. C. Danielson. Phys. Rev. 77, 300-1(1950) Jan. 15 (Letter to the editor).

One of the disadvantages of using a crystal conduction counter is the accumulation of space charge field resulting from the trapping of charge carriers. This space charge field opposes the applied field and may lower the pulse height below the noise level of the amplifier. It has been found that the reduction in the counting rate can be completely eliminated in some diamonds. This is accomplished by violet light irradiation of the diamond, which is normally in the dark. This effect is quite different from the ordinary release of space charge by red light, since the counting rate may be maintained indefinitely at its initial rate after exposure. A tentative explanation of the action of the violet light is given.

1494 Electromagnetically Operated Counter. Harold D. Goldberg and Milton I. Goldberg (to U. S. Atomic Energy Commission). U. S. Patent Application Ser. No. 565,993.

An electromagnetically operated counter wherein signals to be counted are applied to cause stepwise rotation of a rotatable element which is connected to a suitable register. The mechanism involved consists of a rotatable armature having three spaced cores of magnetic material and a pair of diametrically opposed electromagnets with a suitable pulsing circuit to actuate the magnets.

1495 High Energy Neutron Counter. Clyde E. Wiegand and Emilio G. Segre (to U. S. Atomic Energy Commission). U. S. Patent No. 2,493,935, Jan. 10, 1950.

An ion chamber utilizing bismuth for the measurement of high energy neutrons. The ion chamber contains a series of parallel aluminum plates which are covered with a layer of bismuth. An electrical potential is applied between alternate plates. The presence of high energy neutrons is indicated by the fission of bismuth and subsequent ionization of the filling gas and conduction between the plates.

1496 Neutron Detector. Emilio G. Segre and Clyde E. Wiegand (to U. S. Atomic Energy Commission). U. S. Patent No. 2,491,220, Dec. 13, 1949.

A detector of two metal cylinders co-axially mounted, the inner cylinder being open at one end and the space between the inner and outer cylinder being closed and filled with boron trifluoride at a pressure of about 2 atm. The large cylinder is connected to the negative side of a high voltage supply and the inner cylinder to the positive side. A neutron slowing material such as paraffin completely surrounds the outer cylinder. The instrument is particularly adapted to detecting thermal neutrons from weak sources in the presence of gamma radiation.

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1497 Noise in Ionization Chamber Pulse Amplifiers. R. Wilson. Phil. Mag. 41, 66-76(1950) Jan.

The general problem of the detection of heavy ionizing particles, in the presence of γ radiation and background noise from the amplifier, is considered. It is shown that the maximum possible signal to noise ratio is obtained if the input pulse is shaped to a form $\exp\left[-|t-T_D|/\tau\right]$. The signal to noise ratio is also calculated for other common pulse shapes. A practical amplifier circuit is discussed which may be used to detect 100 kv energy protons in the presence of intense γ radiation.

1498 Note on the Ionization Produced by a Rapidly Ionizing Particle in a Proportional Counter or an Ionization Chamber. M. I. Podgoretskiĭ. Doklady Akad. Nauk S.S.S.R. 67, 631-3(1949)(in Russian).

The ionization effect, produced by a particle within a proportional counter or an ionization chamber, is usually regarded as being equal to the energy losses undergone by the particle. However, other circumstances should also be taken into consideration, viz., (1) the ionization effect due to δ-electrons that were produced by the particle before it entered the working space of the chamber and whose energy and direction enabled them to penetrate the chamber, and (2) the fact that some δ-electrons leave the chamber before they have spent there all their energy. The examination of the question shows that if the dimensions of the counter or the chamber are large enough, the circumstances (1) and (2) are ineffective, and the ionization effect can be equated to the particle's energy losses. If, however, the instrument's dimensions are those actually used in practice, the effects of (1) and (2) are not negligible. Thus, denoting by dI the corresponding loss in the ionization effect, it is found that for a meson of 5×10^8 ev energy, traversing a chamber whose aluminum walls are 1 mm thick, the ratio dI/I is about 20%.

1499 The Paths of Electrons in Photographic Emulsions. R. H. Herz. Sci. J. Roy. Coll. Sci. 19, 141-55(1949). (See also NSA 1-662 and 2-1253.)

This work is divided into two parts; the first section describes some preliminary work which led to the indirect tracing of the paths of electrons in insensitive emulsions. The second section is devoted to the study of electron tracks in the later, electron sensitive emulsions. Photomicrographs of electron tracks of various energies are reproduced.

1500 The Photographic Effect of Protons of Medium Velocity. II. Communication: Measurements Using Ilford Q Plates. Peter Brix and Hans-Georg Dehmelt. Z. Physik 126, 728-33(1949)(in German).

Ilford Q plates which contain little gelatin, were irradiated with protons of energies ranging from 5 to 17 kev, and the density of the plates was measured. It was found by grain counts that at 5 kev approximately every fifth, and at 17 kev every second proton makes a grain developable. The energy dependence and yield for the individual process were in agreement with data obtained with more highly energetic particles (Brix, Z. Physik 126, 35(1949)).

1501 Portable Radioactivity Indicator for Low-Level Surveys. B. P. McKay and John L. Wood. Anal. Chem. 21, 1588(1949) Dec. (Aids for the analyst).

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A simple monitor has been constructed for use of the chemist who is concerned with the qualitative detection of radioactivity. Useful in experiments carried out at the tracer level when it is known that no health hazard exists, the monitor emits loud clicks, and flashes a neon glow tube with impulses transmitted from a Geiger-Mueller tube. When the tube is brought near a source of radiation, an increase in the rate of clicks is readily discernible at levels as low as twice the background. Contamination of beakers, spatulas, rubber gloves, etc., is instantly detected. The processes of decontamination may be monitored continuously until entirely effective. The high voltage supply permits the use of commercially available Geiger-Mueller tubes which operate between 800 and 2,250 v.

1502 Radiation Counters. John A. Simpson, Jr. (to U. S. Atomic Energy Commission). U. S. Patent Application Ser. No. 744,499.

Geiger-Mueller and proportional counters operating at low potentials (about 125-300 v) obtained by utilizing certain ratios of diameters of the electrodes and particular mixtures of noble gases as the ionizing medium are covered in this application.

1503 Radiation Detecting Apparatus. A. Ghiorso and Carroll M. Gordon (to U. S. Atomic Energy Commission). U. S. Patent No. 2,490,298, Dec. 6, 1949.

An argon filled radiation detection counting chamber fitted with an air-lock system for introducing samples. Means are provided to prevent pollution of the counting chamber when the air-lock is open to introduce the sample to the counting chamber and for transferring the sample from the air-lock to the counting chamber.

1504 Radiation Detector. Donald G. C. Hare (to The Texas Co., New York). U. S. Patent 2,486,944, Nov. 1, 1949.

A radiation detector for γ radiations which, it is claimed, has many times the sensitivity of the ordinary Geiger counter is described. This patent is partly based on prior claims appearing as Patent 2,397,071, March 19, 1946. The detector consists of a group of small γ-ray counters arranged in parallel, each consisting of a metallic tubular member; thin metallic plates in parallel are enclosed in each tube, through which wires pass. The plates collectively form the cathode, a and the wires form the anode of this device.

1505 Rejuvenation of Geiger-Mueller Tubes. L. Shepard. Rev. Sci. Instruments 20, 217-8(1949) Mar. (Laboratory and shop note).

Geiger-Mueller tubes filled with a self-quenching mixture of argon and ethanol deteriorate with use, and the original counting characteristics are not restored by refilling the tube. However, it has been found that these characteristics may be restored by heating the central wire to a dull red color while the tube is being evacuated, and then refilling.

1506 Secondary Discharges in Geiger-Mueller Counters and the Coefficient of Electron Liberation. E. Beretta and A. Rostagni. Nuovo cimento 6, 393-6 (1949) Sept. (in Italian).

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By observing the time distribution of intervals between pulses in a Geiger-Mueller counter, it is possible to discriminate between spurious pulses attributable to secondary emission and those due to other causes. In this way a determination can be made, at least for fast counters, of the coefficient k of liberation of electrons from surfaces reached by ions. Values of k are given for metal and glass surfaces hit by molecular ions of ethyl alcohol.

1507 A Study of a Wilson's Cloud Chamber with Large Sensitive Time and of Its Application in Measuring Range of α-Particles Emitted by Pu^{239}. H. P. De. Indian J. Phys. 23, 363-70(1949) Aug.

A cloud chamber is described which has a very long sensitive time (0.8 sec). This was brought about by the increase of the time taken for the completion of the expansion. The author used this cloud chamber to determine the range of α particles from Pu^{239}, which he found to be 3.5 cm under standard condition, by comparison with the range of the α particles from Po^{210}.

1508 Temperature Dependence of Scintillation Pulses in Anthracene. G. G. Kelley and M. Goodrich. Phys. Rev. 77, 138(1950) Jan. 1 (Letter to the editor).

Measurement has been made of the decay constant and light output of anthracene scintillation pulses as a function of temperature. Values of the decay constant were obtained by photographing a series of individual pulses at each temperature using an oscilloscope with a vertical rise time of 6×10^{-9} sec. These experiments indicated that the decay is exponential, the decay constant varying linearly with the temperature. The line has positive slope and intercepts the temperature axis at $-273°C$. The value of the constant at the temperature of liquid nitrogen is in good agreement with the value given by Collins (Phys. Rev. 74, 1543(1948)). The temperature dependence of the size of the pulses was investigated with a scintillation spectrometer of the type described by Jordan and Bell (Nucleonics 5, 30(1949)). The size of the pulses from a 1P28 photo-multiplier showed very little temperature variation, but with the 1P21 the pulses were 30% larger at $-60°C$ than at room temperature. Several possible explanations are offered for this variation.

1509 Microwave Magnetic Absorption Spectrum of Atomic Cesium. A. Roberts, Y. Beers, and A. G. Hill. M.I.T. Research Laboratory of Electronics Technical Report No. 120, June 6, 1949. 31p. (NP-1235.)

A new method using microwave cavity techniques has been developed for the study of the absorption of radiation in the radio-frequency region by atoms and molecules. The present paper describes the application of this method to the study of the hyperfine structure of the ground state of Cs^{133}. Cesium vapor is introduced into a high Q resonant cavity which in turn is used to stabilize a microwave oscillator. The cavity is tuned to within a few megacycles of the hyperfine structure $\Delta\nu$. By application of a magnetic field the absorption line is split into Zeeman components, any one of which may be brought near to the resonant frequency of the cavity, causing

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a shift in this frequency due to the change in magnetic permeability accompanying the absorption. Incorporation of a small 30-cps component in the applied field causes a 30-cps frequency modulation of the oscillator stabilized to the cavity. This modulation may be detected by a suitable radio receiver. A study of the Zeeman components, taking into account second order terms in the Breit-Rabi formula (Phys. Rev. 38, 2082 (1931)), enables evaluation of $\Delta\nu$ as 9192.513 Mc/sec with a probable error no greater than 0.030 Mc/sec. A previous measurement by Millman and Kusch (Rev. Mod. Phys. 18, 323(1946)) of 9192.6 ± 0.5 Mc/sec using molecular beam techniques is in excellent agreement with this value. References included. (auth)

1510 A Comparison of the g Value of the Electron in Hydrogen with That in Deuterium. Edward B. Nelson and John E. Nafe. Phys. Rev. 76, 1858-60 (1949) Dec. 15.

The g value of the electron in the $^2S_{1/2}$ state of H has been compared with the g value of the electron in the corresponding state of D by the atomic beam magnetic resonance method. The frequencies, f_H, of the transition $(1,0 \leftrightarrow 1,-1)$ in H, and f_D, of the transition $(\frac{1}{2},-\frac{1}{2} \leftrightarrow \frac{3}{2},-\frac{3}{2})$ in D were observed in the same magnetic field and the ratio $(g_J)_H/(g_J)_D$ was computed from the Breit-Rabi formula (Phys. Rev. 38, 2028 (1931)). The principal uncertainty is caused by the drift of the magnetic field. The average of 36 observations in 4 runs in which f_H and f_D were measured alternately is $(g_J)_H/(g_J)_D = 1.000004 \pm 0.000025$. The average of 3 runs in which the two resonances were observed simultaneously is $(g_J)_H/(g_J)_D = 0.999991 \pm 0.000010$. The uncertainty indicated in each result is the mean deviation of the residuals. It is concluded that the g value of the electron when bound to the proton differs from that when bound to the deuteron by less than 0.001%.

1511 Investigation of the Fine Structure of Hydrogen Spectrum by the Radio-Resonance Method. A. Lubny-Gertsyk. Zhur. Eksptl. i Teoret. Fiz. 19, 950(1949)(Letter to the editor, in Russian).

The fine structure of hydrogen lines has recently gained renewed attention by the discovery of the displacement of the levels $2S_{1/2}$ and $2P_{1/2}$ (Lamb et al, Phys. Rev. 72, 241 (1947)), explained by an interaction of the electron with the quantized electromagnetic field (Bethe, Phys. Rev. 72, 339 (1947)). The phenomenon was detected by the radio-resonance method, in which excited hydrogen atoms were transferred, by the action of a high-frequency electric field of resonance frequency, from the metastable state $2S_{1/2}$ into the radiating state $2P_{1/2}$, the number of excited atoms being thus greatly reduced. The present author shows that a similar effect can be detected, by the same method, with levels of higher quantum numbers, e.g., as a displacement of the levels $3S_{1/2}$ and $3P_{1/2}$ of hydrogen. The displacement is here $\Delta\nu \sim 0.01\ cm^{-1}$, (resonance $\lambda \sim 1$ m). The resonance effect of a high-frequency electric field should be observed as a change in the intensity of the red line, which will depend on the ratio between the numbers of excited atoms on levels $3S_{1/2}$ and $3P_{1/2}$, this ratio depending on the conditions of the discharge in the tube. A general scheme for the realization of the experiment is suggested.

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1512 Neutron Penetration and Slowing Down at Intermediate Distances through Medium and Heavy Nuclei. H. A. Bethe, L. Tonks, and H. Hurwitz, Jr. AECD-2790, Sept. 29, 1949, decl. Jan. 16, 1950. 36p.

This reports new theoretical results and numerical calculations of neutron slowing down and penetration to fairly large distances from the source, assuming constant mean free path and no absorption. The Placzek one-velocity problem which results from a Laplace transformation of the Boltzmann equation is solved approximately by keeping only a finite number of harmonic terms in the Laplace transform of the scattering function but not restricting the expansion of the neutron density. The Laplace inversion is carried out by the method of steepest descent. Numerical results are given for nuclei of mass infinity and mass 9 carried out to three orders of approximation, namely zeroth, first, and second. They show the expected transition behavior between age theory and the asymptotic exponential behavior. The accuracy of the method is high, being greater than that of the numerical work over the useful range of the calculations. Rough agreement with Wick's asymptotic results for mass 12 is found. (auth)

1513 A Monte Carlo Computation Being Made for Neutron Attenuation in Water. M. Lewis Nelson. AECD-2795, Nov. 7, 1949, decl. Jan. 25, 1950. 25p.

Methods are described for solving a Monte Carlo problem, for which computations are underway. The problem is as follows. A plane, monoenergetic (10-mev) source of neutrons is embedded in a three-dimensionally infinite body of water. By tracing the life histories of 1,200 neutrons according to the "Monte Carlo" method in connection with described sampling techniques, an estimate is to be computed of: (1) the attenuation by infinite slabs of several thicknesses of a plane, 10-mev source of neutrons; these estimates can be computed for various distributions in direction of the source neutrons; (2) other physical quantities similar to that of (1); (3) the "efficiency" of the various techniques used with the intention of obtaining both the experience and information on which can be based a choice of significantly improved sampling.

1514 Asymptotic Distribution of Neutrons from a Point Source in a Medium Containing Hydrogen and an Isotropic Scatterer. T. A. Welton and G. Goertzel. AECD-2796, Nov. 7, 1949, decl. Jan. 25, 1950. 13p.

This report is one of a series on shielding and represents part of the work of a summer group working principally at Oak Ridge National Laboratory. A theoretical treatment of the problem is given.

1515 The Total Cross Section of Mn^{55}. C. O. Muehlhause. AECU-659(UAC-179), nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

The total cross section of Mn^{55} has been determined by measuring Mn transmission curves at specific neutron energies. Neutrons were selected by placing various resonance scatterers in a Cd-filtered neutron beam from the Argonne heavy water reactor and counting the scattered neutrons. This method yielded good energy resolution. The following total cross sections were obtained for Mn at the various energies indicated:

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Detector	Energy (ev)	σ_T (Mn)-b
$_{72}Hf^{even}$	7.7	3.47
$_{62}Sm^{152}$	10.0	3.41
$_{74}W^{186}$	~15	3.38
$_{27}Co^{59}$	115	6.17
$_{30}Zn^{67}$	480	~17
$_{24}Cr^{53}$	2400	4.15
$_{11}Na^{23}$	~3500	3.55

1516 Proposed Technique for Measuring Neutron Inelastic Scattering Levels. Joe Keagy Bair. NEPA-1260, Jan. 12, 1950. 4p.

This is not an abstract; the document is reproduced below in its entirety.

It has been proposed by Feld (Phys. Rev. 70, 429(1946)) that exoergic n-p reactions be used as the basis for a low energy neutron spectrometer by measuring the pulse height distribution of the ejected protons. Nitrogen was suggested as the active element. The nitrogen n-p cross section has been measured by Barschall and Battat (Phys. Rev. 70, 245 (1946)) up to about 1.7 Mev neutron energy. The cross section varied slowly with neutron energy to about 0.5 Mev. Fairly sharp resonances were found at approximately 0.55 and .71 mev with a wider resonance at 1.45 Mev. It has also been proposed that such a detector, at least in the region below the first resonance, might be useful in investigating the existence of low energy inelastic scattering levels.

The writer wishes to propose an alternate method using a nitrogen filled counter to investigate inelastic scattering levels. In this new technique, monoenergetic neutrons from, for example, the lithium p-n reaction would be scattered by the material under investigation into the nitrogen filled counter. The resulting counter pulses, after amplification, would be fed into a single channel differential discriminator. The discriminator bias and channel width would be adjusted so that only those pulses whose height indicated that they were the result of neutrons absorbed by the 0.55 Mev nitrogen resonance would be recorded. One would thus have a detector sensitive only to neutrons of a narrow band of energies centered about 0.55 Mev. From a plot of the counting rate of such a detector as a function of the energy of the neutrons incident on the scatterer, one can obtain information concerning the location of the level involved, its width, and its cross section for neutrons of the bombarding energy. If the work were repeated using the .71 Mev nitrogen resonance, the curve would be shifted toward higher bombarding energies and thus a new cross section is obtained corresponding to the new energy. In this manner some information on the variation with energy of the individual level cross sections could be obtained. The proposed method will probably be limited to levels in the region below about 1.5 Mev because of such effects as the nitrogen n-α reaction and nitrogen recoils.

The possibility of obtaining coincidences between the inelastically scattered neutron and the resulting gamma rays might be mentioned although present monoenergetic sources are probably not sufficiently intense to permit such measurements.

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1517 Angular Distribution of Neutrons from Targets Bombarded by 18-Mev Deuterons. P. Ammiraju. Phys. Rev. 76, 1421-2(1949) Nov. 1 (Letter to the editor).

An investigation has been made of the spatial distribution of fast neutrons from targets of Be, Na, Cu, Ta, Pb, and Th bombarded with 18-Mev deuterons. Copper was used as a threshold detector and the target thicknesses were sufficient to stop the neutrons within the target. In all cases a fairly sharp forward peak in the distribution was observed. Curves of the experimental angular distributions of the neutrons from Be and Cu are shown and compared with theoretical curves calculated from Serber's stripping theory (Phys. Rev. 72, 1008(1947)). The following table summarizes the results obtained for Be, Cu, and Pb for the half-width (i.e., full-width at half maximum):

Target	Half-width in degrees, experimental	stripping theory
Be	41°	31°
Cu	45°	46°
Pb	47°	70°

Although there seems to be a perceptible increase in the half-width with increase in atomic number, the rate of increase is definitely not in agreement with stripping theory.

1518 Applications of Total Reflection of Neutrons. M. Hamermesh. Phys. Rev. 77, 140(1950) Jan. 1 (Letter to the editor).

It is noted that the total reflection of neutrons provides a powerful technique for the measurement of coherent scattering cross sections and phases, which may often be applicable when other methods fail. This method may be used when the cross section is low, as in the case of vanadium for instance. It may be used for measurements on highly absorbent materials. By using hydrogen compounds as mirrors, one could determine the coherent scattering cross section of hydrogen. Total reflection data could also give information about the neutron-electron interaction.

1519 The Comparison of Weak Neutron Fluxes by Using Ethyl Iodide. P. F. D. Shaw and C. H. Collie. J. Chem. Soc., 1217-21(1949) May.

A quantitative study of the factors influencing the reproducibility of extractions of radioactive iodine from neutron-irradiated ethyl iodide has been made with a view to furnishing a sensitive method of comparing weak neutron fluxes. Exchange rates between the radioactive species produced and the inactive ethyl iodide have been measured, and their bearing on the reproducibility is discussed. This method being used, the statistical error of the counts obtained from a weak neutron source was reduced from 14% for dysprosium oxide and indium detectors to 1%.

1520 The Inelastic Scattering of Neutrons by Light Nuclei. L. E. Beghian, M. A. Grace, G. Preston, and H. Halban. Phys. Rev. 77, 286-7(1950) Jan. 15 (Letter to the editor).

The authors investigated the inelastic scattering of 2.5-Mev neutrons by light nuclei. In many such elements the level spacing is so wide that only the lowest level is excited by neutrons of this energy. Thus the γ rays produced in this process are homogeneous and this facilitates the determination of their energy and intensity. The neutrons were produced by the d-d reaction using an occluded target with deuterons of 100-kev energy. Disk-shaped scatterers, 2 cm in diameter and 5 mm thick, were placed directly in contact with the target. The γ rays from the scatterer were detected in a pair of thinwalled glass Geiger-Mueller counters set up in coincidence, using a polystyrene converter in front of the counter to produce the secondary electrons, while the absolute neutron intensity was determined by using a proton recoil ionization chamber. Inelastic and total scattering cross sections and γ ray energies are tabulated for Mg, S, and F.

1521 On the β Decay of the Neutron. V. B. Berestetskiĭ and I. Ya. Pomeranchuk. Zhur. Eksptl. i Teoret. Fiz. 19, 756-7(1949)(Letter to the editor, in Russian).

The possibility of a β decay of the neutron is seen from the fact that its mass exceeds that of the proton by 755 kev; and, by comparing this process with such a β decay of a light nucleus in which the maximum energy value of the β spectrum is of the same order of magnitude with the above mass difference, it is concluded that the half-life period of the β disintegration of the neutron must be about 15-30 min. However, comparisons of that kind are based on the assumption of an approximate equality of conditions under which a nucleon undergoes transformations within a nucleus and in the free state. Not in all variants of the β decay theory such an assumption is acceptable. It is shown that in the pseudoscalar variant the probability of a β decay of a neutron is much lower than that of a β disintegration of a nucleus with an equal maximum energy value of the β spectrum; the half-life period of the neutron must be 10^3-10^4 times longer than that of such a nucleus. The experimental evidence on the question is still in the rudimentary stage; it is known only that this period must exceed 15 min, (Snell et al, Phys. Rev. 74, 1217(1948)). Future findings will permit the right choice between the many variants of the theory.

1522 A Photographic Study of Neutrons from Al + H^2. R. A. Peck, Jr. Phys. Rev. 76, 1279-82(1949) Nov. 1.

The (dn) reaction on aluminum has been studied using Eastman NTB emulsions. Twenty-two hundred head-on recoil tracks are plotted, and ten groups are identified (with widths and intensities), extending up to 9 Mev excitation of the product Si^{28} nucleus. The first two excited levels, at 1.8 and 4.5 Mev, agree with γ-ray energies and inelastic scattering. The reaction Q value (9.08 ± 0.20 Mev) determines the mass difference $Si^{28} - Al^{27} = +0.996\ 05 \pm 0.20 \times 10^{-3}$ mass unit. 14 references.

1523 Slow-Neutron Cross-Sections and the Quadrupole Moments of Nuclei. B. H. Flowers. Atomic Energy Research Establishment Report No. AERE-T/R-437, Nov. 1949. 8p.

Tables and graphs are presented.

1524 Summary of the Research Progress Meeting of September 8, 1949. H. P. Kramer. UCRL-463, Oct. 13, 1949. 13p.

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The following topics were discussed at this meeting: F. M. cyclotron at Montreal; synchrotron experiments; lifetime of the π^+ meson; isotopes of bismuth.

1525 Physics Division Quarterly Report; August, September, and October, 1949. UCRL-541, Dec. 7, 1949. 34p.

The status of the following programs of general physics research is reported. (1) Cloud chamber program: energy distribution of synchrotron x-rays. (2) Film program. (3) A multiple scattering deflector for the 184-in. cyclotron. (4) Bismuth fission chamber measurements: bismuth fission cross sections for 90 and 270 Mev neutrons. (5) Fission induced in uranium by π^- meson capture. (6) Shower curves in matter produced by 335-Mev bremsstrahlung. (7) Neutron-proton scattering at small scattering angles. (8) π^- capture in H_2. (9) p-p scattering near 30 Mev. (10) Excitation curve for $C^{12}(p,pn)C^{11}$ reaction. (11) p-p scattering - 340 Mev: measurements of differential scattering cross sections with proportional counters covering the range of scattering angles in the center of mass system 41° to 90°. (12) β spectra of Zn^{62} and Cu^{62}. (13) Transition curves in lead of photons responsible for nuclear reactions. (14) Theoretical studies: p-p scattering; mesons; showers and (γ,x) reactions; neutron cross sections; machines.

The status of the following programs of accelerator operation and development is reported. (1) 184-in. cyclotron: proton probe; electric deflector; movable shield; carbon dee shield; magnetic deflector sections. (2) 60-in. cyclotron. (3) Synchrotron. (4) Linear accelerator and Van de Graaff machines. (5) Bevatron development.

1526 Atomic Binding Energies. W. E. Duncanson and C. A. Coulson. Nature 164, 1003-4(1949) Dec. 10 (Letter to the editor).

In an earlier paper (Proc. Roy. Soc. Edinburgh 62A, 37 (1944)) the authors have published the results of some calculations of analytical atomic wave functions for the ground states of atoms lithium to neon. The associated energies have now also been calculated and are tabulated in this article. These energies are compared with their experimentally determined values, obtained by summing all the ionization potentials of the atom. The differences between experimental and theoretical values are in all cases less than 1%. The wave functions used in the calculations are listed.

1527 The Electric Quadrupole Moment of the Deuteron. G. F. Newell. Phys. Rev. 77, 141(1950) Jan. 1 (Letter to the editor).

As has been pointed out previously (Kellogg et al, Phys. Rev. 57, 677(1940); Nordsieck, ibid. 58, 310(1940); Ishiguro, J. Phys. Soc. Japan 3, 133(1948)), the determination of the quadrupole moment of the deuteron requires finding the ratio of the quadrupole interaction energy to the value of the electric field gradient at the D nucleus. The interaction energy in HD and D_2 molecules has been determined experimentally by Kellogg, but the field gradient must be calculated from a suitable electronic wave function for the molecule. Such calculations have already been carried out by Nordsieck and Ishiguro. By means of the variation principle, a new six-parameter electronic wave function has been determined for the ground state of the molecule. The field gradient as calculated from this wave function leads to the value $Q = 2.766 \times 10^{-27}$ cm^2.

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1528 Electron-Nuclear Potential Fields from Hyperfine Structure. M. F. Crawford and A. L. Schawlow. Phys. Rev. 76, 1310-17(1949) Nov. 1.

Theoretical predictions concerning the effects of nuclear size on hyperfine structure are compared with experimental data. New data show that isotope shifts of ns levels in Tl III are proportional to $\psi^2(0)$ as predicted. The fractional change in nuclear radius for the addition of two neutrons, determined from s electron shifts in Hg II, Tl III, Pb IV, is the same for the three elements. Köhler's results for Tl II are consistent with those for Tl III when allowance is made for the mutual screening of the valence electrons. Corrections for the approximation of the perturbation method and for screening of inner electrons by the valence electron are considered and found to be appreciable. Even after applying the corrections, the fractional change in nuclear radius is smaller than expected if the charge is uniformly distributed throughout the nucleus and the volume is proportional to the mass. Values of nuclear magnetic moments of thallium deduced from hyperfine structure measurements are compared with those measured by radiofrequency induction and found to be 15% lower. This discrepancy is removed by the correction for finite nuclear size assuming either a uniform charge distribution or a concentration of charge toward the surface of the nucleus. Thus both the isotope shift and the magnetic effect indicate that the electron-nuclear potential is consistent with a charge distribution of this form and that the nonelectrical forces between electrons and nuclei are relatively small. 25 references.

1529 The Hyperfine Structure of Nuclear Moments of the Stable Chlorine Isotopes. Luther Davis, Jr., Bernard T. Feld, Carrol W. Zabel, and Jerrold R. Zacharias. Phys. Rev. 76, 1076-85(1949) Oct. 15.

The hyperfine structure of the $^2P_{3/2}$ ground states of Cl^{35} and Cl^{37} is investigated by the atomic beam magnetic resonance method. Values of the magnetic dipole interaction constant, a, and the electric quadrupole interaction constant, b, are found to be

$a_{35} = 205.288 \pm 0.010$ Mc/sec, $a_{37} = 170.686 \pm 0.010$ Mc/sec,
$b_{35} = 55.347 \pm 0.020$ Mc/sec, $b_{37} = 43.256 \pm 0.020$ Mc/sec.

No octupole interaction is required to account for the experimental results. A simple method is introduced for calculating accurate values of the electric quadrupole moments Q from these data and the corresponding values are

$$Q_{35} = -(0.0795 \pm 0.0005) \times 10^{-24} \text{ cm}^2$$

and

$$Q_{37} = -(0.0621 \pm 0.0005) \times 10^{-24} \text{ cm}^2.$$

This method can be extended to many other cases for which the interaction constants a and b and the nuclear gyromagnetic ratio are known. Experimental details are given for the production and detection of beams of atomic chlorine. 16 references.

1530 The Influence of Nuclear Structure on the Hyperfine Structure of Heavy Elements. Aage Bohr and V. F. Weisskopf. Phys. Rev. 77, 94-8(1950) Jan. 1.

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The influence on the hyperfine structure of the finite size of the nucleus is considered and the effect is calculated for simple models of the nuclear magnetism. It is pointed out that the distribution of magnetic dipole density over the nuclear volume may vary greatly from nucleus to nucleus depending on the relative contributions of spin and orbital magnetic moments to the total nuclear moment. On this basis an attempt is made to interpret the observed discrepancy between the hyperfine structure ratio of the Rb isotopes and the ratio of the magnetic moments as determined by the magnetic resonance method. A study of such anomalies may give some information regarding the structure of nuclear moments, in particular, regarding the nuclear g_L factor.

1531 Nuclear Moments. Francis Bitter. Nucleonics 5, 16-26, 41(1949) Oct.

A number of recent concepts concerning nuclei are discussed. The following are considered in nontechnical fashion: nuclear states, the use of resonance to determine nuclear moments, nuclear spins, nuclear magnetic moments, and nuclear electric quadrupole moments.

1532 On the Hyperfine Structure of the $^2P_{\frac{1}{2}}$ state of Tl^{205} and Tl^{203}. A. Berman, P. Kusch and A. K. Mann. Phys. Rev. 77, 140-1(1950) Jan. 1 (Letter to the editor).

It has been found that an atomic beam of thallium may be evaporated from an iron oven of the type conventionally used in molecular beam research and that the beam may be detected by the formation of positive ions on a hot oxidized tungsten filament. It has, therefore, been possible to observe the hyperfine structure of the $^2P_{\frac{1}{2}}$ ground state of Tl^{205} and Tl^{203} by the atomic beam magnetic resonance method. Since the zero field hyperfine structure separation of the two F levels is very large, observation of the lines $\Delta F = \pm 1$ presents large technical difficulties. The $\Delta\nu$ has, therefore, been determined from an observation of the lines $\Delta F = 0$, $\Delta m_F = \pm 1$. The authors' results do not agree with those of Poss (Phys. Rev. 75, 600(1949)), the discrepancy in the two results being much larger than experimental error.

1533 A Remark Concerning the Electric Quadrupole Moments of the Copper Isotopes Cu^{63} and Cu^{65}. Peter Brix. Z. Physik 126, 725-7(1949)(in German).

It is shown that an analysis of the hyperfine structure of the Cu I lines λ5,700 ($3d^94s^2\ ^2D_{3/2} - 3d^{10}4p\ ^2P^0_{1/2}$) and λ 5782 ($3d^94s^2\ ^2D_{3/2} - 3d^{10}4p\ ^2P^0_{3/2}$) of the isotopes 63 and 65 as found by Schüler and Schmidt (Z. Physik 100, 113(1936)), using the ratio of the magnetic moments $\mu_{65}/\mu_{63} = 1.0711 \pm 0.0002$ as determined by Pound (Phys. Rev. 73, 523(1948)), leads to the following values of the electric quadrupole moments:

$$q_{63} = (-0.26 \pm 0.10) \times 10^{-24}\ \text{cm}^2$$

$$q_{65} = (-0.15 \pm 0.10) \times 10^{-24}\ \text{cm}^2.$$

1534 Remarks on the Cross Sections of the Reactions (γ,n) and on the Structure of Light Nuclei. Raymond Chastel. Compt. rend. 228, 1803-4(1949) June 8 (in French).

The theoretical interpretation of the reaction (γ,n) presents certain difficulties, pointed out by Hirzel and Waeffler (Helv. Phys. Acta 20, 373(1947); 21, 200(1948)) and by Jensen (Proc. Phys. Soc. 61, 579(1948)). Following a suggestion of Joliot, the present author attempted to discover a relationship between the relative values of the cross section of the (γ,n) reaction and the proton-neutron groupings in the nuclei. He found that in the curve representing the (γ,n) cross section as a function of Z, the minima correspond to nuclei of the type $_{2k}Z^{4k}$, i.e., to those equivalent to a whole number of α particles (e.g., $_8O^{16}$, $_{12}Mg^{24}$, $_{14}Si^{28}$). The intermediate nuclei, possessing neutrons that do not form an α group, seem to yield them more readily than do the $_{2k}Z^{4k}$ nuclei. For Z > 20, the curve undergoes a sudden upward sweep, which is in agreement with the fact that, neutrons being in excess, no further formation of $_{2k}Z^{4k}$ nuclei is possible.

1535 Spins, Magnetic Moments and Nuclear Structure. G. J. Bene, P. M. Denis, and R. C. Extermann. Helv. Phys. Acta 22, 606-9(1949) Dec. 1 (in French).

This article is a study of the relation existing between the nuclear spins and magnetic moments on the one hand, and the nuclear structure, as evidenced by the magic numbers, on the other. Examining a plot of the nuclear magnetic moment against the nuclear spin the author arrives at the following empirical law: two nuclei which differ only by an even number of protons or neutrons have similar magnetic moments provided that their spins are equal. The magnetic moment is then plotted against Z for the two cases "Z even, N odd" and "Z odd, N even." These plots give additional information with which it might be possible to determine the approximate magnetic moment of a nucleus of known composition as soon as it's spin is known.

1536 Electronic Pile Simulator. P. R. Bell and H. A. Straus. AECD-2764, Nov. 26, 1947, decl. Dec. 20, 1949. 17p.

A device has been made that follows the same set of kinetic equations as a chain reacting pile. The voltage output varies as a function of time as the neutron flux would vary in a pile. A potentiometer varies the effective multiplication factor and can be considered as a control rod. Five delayed neutron periods are simulated. A high precision electronic integrator is used and the instrument is capable of an accuracy much better than 1%. (auth)

1537 Engineering Aspects of Nuclear Reactors. I. L. A. Ohlinger. Nucleonics 5, 38-49(1949) Dec.

The author discusses the fission process and describes how this process is utilized in a pile. Piles are classified as fast, slow, or intermediate, and the size and shape of the pile are discussed as functions of the type of operation and the type of fuel used. Processes for the production or separation of the nuclear fuel are briefly outlined, and the homogeneous and heterogeneous pile structures are compared with regard to their efficiencies and modes of operation. The form and arrangement of the fuel and moderator are then described in some detail.

1538 Heat Transfer and Atomic Energy Symposium at the 42nd Meeting of the A. I. Ch. E. Can. Chem. Process Inds. 34, 46, 48, 50(1950) Jan.

A portion of the program offered by the American Institute of Chemical Engineers at its 42nd meeting in Pittsburgh, Pa., on December 4 - 7, 1949, consisted of a four-paper sympo-

sium on atomic energy development in the United States. The topics of the papers presented included: The Current Status of Reactor Development, by L. R. Hafstad; A Comparison of Nuclear Properties of Various Materials to Illustrate the Criteria for Choice of Moderator and Construction Elements in the Nuclear Pile, by W. H. Zinn; The Predicted Use of Radioisotopes in Reducing Manufacturing and Transportation Costs of Petroleum Products, by L. B. Emlet; and Difficulties in Current Atomic Energy Operations Due to the Fact that Fissionable Materials are Active Only in Large Quantities, by S. Lawroski.

1539 Some Design Problems of Nuclear Power Plants. Ward F. Davidson. Nucleonics 5, 4-15(1949) Nov.

This article is a review of the engineering problems occurring in the design and operation of nuclear power plants. After a brief discussion of the underlying physics, various basic engineering problems are discussed, among them the temperature range in which it is thermodynamically desirable and technically feasible to run the working fluid, means of keeping the loss of neutrons from a reactor to a minimum, and of providing stable and sensitive controls. Attention is also given to protective measures against radiation and the choice of suitable radiation resistant materials in the construction of a nuclear power plant. Finally the economical aspect both of plant construction and of the cost of energy production are considered.

1540 Preliminary Report on the Absolute Excitation Curve for the $C^{12}(p, pn)C^{11}$ Reaction from Threshold to 350 Mev. L. Aamodt, V. Peterson, and R. Phillips. UCRL-526, Nov. 21, 1949. 7p.

Preliminary results are given for data obtained by 3 different methods, over the low, intermediate, and high energy regions of the curve. The data above 100 Mev to a maximum proton energy of 350 Mev was obtained by using the deflected proton beam of the 184-in. cyclotron with copper absorbers to degrade the energy of the protons. Below about 100 Mev this method is inaccurate due to excessive range straggling of the protons, and also a direct connection with the 32-Mev linear accelerator data is impossible. For data from the threshold (18.5 ± 0.3 Mev) up to 32 Mev, a stack of carefully molded polystyrene foils 0.0025 in. to 0.010 in. thick were bombarded in the beam of the linear accelerator and then counted under an end window Geiger-Mueller counter. To bridge the gap between 32 and 100 Mev the relative excitation curve of Chupp and McMillan (Phys. Rev. 72, 873(1947)) was corrected for absorption of protons in carbon and fitted to the absolute points already obtained.

1541 Threshold for the $Cu^{63}(\gamma,n)Cu^{62}$ Reaction. William Ogle and John McElhinney. AECU-665, Oct. 21, 1949. 11p.

The energy threshold for this reaction has been determined experimentally by comparison with the $N^{14}(\gamma,n)N^{13}$ and the $F^{19}(\gamma,n)F^{18}$ thresholds, both of which lie close to the copper threshold and can be calculated with fair accuracy from mass data. In order to determine the gamma-neutron thresholds of the materials under investigation the samples were irradiated by the x-ray beam from the betatron at various maximum bremsstrahlung energies. The induced radioactivity

resulting from the γ-n reaction was then measured with a geiger counter and plotted as a function of x-ray energy. The peak bremsstrahlung energy at which the activity appears to go to zero is interpreted as the γ-n threshold of the material. The energy threshold for the copper reaction was determined to be 10.8 ± 0.2 Mev.

1542 Progress Report in Radiochemistry Group I for Period Nov. 1, 1948, to May 1, 1949. A. F. Voigt. ISC-64, Oct. 5, 1949. 20p.

The status of work on the following projects is reported: artificial radioactivities produced by deuteron bombardment of europium and neutron bombardment of gadolinium; work on zirconium-hafnium separation; impurities in radiophosphorus; studies on long-lived krypton; radioactive isotopes from germanium; and dead-time in Geiger-Mueller counters.

1543 Cross Section of the $C^{12}(p,\gamma)N^{13}$ Reaction at Low Energies. Carl L. Bailey and William R. Stratton. Phys. Rev. 77, 194-6(1950) Jan. 15.

The efficiency of the nuclear reaction $C^{12}(p,\gamma)N^{13}$ has been measured over the energy range from 125 to 200 kev, with results which are in good agreement with those recently published by Hall and Fowler (Phys. Rev. 77, 197(1949)). The cross section ranges from 1.0×10^{-33} cm^2 at 128 kev to 23×10^{-33} cm^2 at 194 kev. The thick-target yield of the reaction was measured, by detecting the N^{13} positron activity with an absolutely calibrated counter, and the cross sections were obtained by differentiation of the thick-target yield curve.

1544 The Cross Section for the Radiative Capture of Protons by C^{12} near 100 Kev. Robert Noel Hall and William Alfred Fowler. Phys. Rev. 77, 197-204 (1950) Jan. 15.

A low voltage accelerator and high current ion source have been used to determine the cross section of the reaction $C^{12}(p,\gamma)N^{13}$ over the energy range from 88 to 128 kev. A counter arrangement is described which detects 26% of all the positrons from the decay of the N^{13} produced in the reaction and which has a low background rate of 5.5 counts/min. With this accelerator and detector, yields of the order of 10^{-10} positron/proton and cross sections as low as 10^{-30} barn or 10^{-34} cm^2 can be measured with errors of the order of ± 20%. The cross section for the $C^{12}(p,\gamma)N^{13}$ reaction has been found to fit the semiempirical expression $0.0024E^{-1}$ exp $[-6E^{-}]$ barn with E in Mev over the energy range measured. This is in satisfactory agreement with the Breit-Wigner one-level dispersion formula using constants determined at the 456-kev resonance. The astrophysical implications of these results in connection with the carbon-nitrogen cycle of nuclear reactions in stellar interiors are discussed.

1545 Deuteron Bombardment of Boron Isotopes. Emmett L. Hudspeth and Charles P. Swann. Phys. Rev. 76, 1150-6(1949) Oct. 15.

The excitation curve for $B^{11}(d,p)$ has been obtained by observing the intensity of the β rays from B^{12} as a function of bombarding voltage from about 0.3-1.85 Mev. No resonance structure was observed in this region of bombardment. The yield at 1.47 Mev is approximately 10^7 β rays/μcoulomb of

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deuterons. The short-range protons which are formed in the preceding reaction were also observed in photographic plates, and range measurements showed that the Q value of the reaction is 0.15 Mev. It is believed that this value does not represent the formation of B^{12} in its ground state, however, but in an excited state at about 1.1 Mev. A group believed to be protons of higher energy (corresponding to Q = 1.25 Mev) but of much lower intensity was subsequently observed. It was shown, by bombardment of enriched B^{10} and of normal boron, that a γ ray of ~ 1.1 Mev energy is associated with the disintegration of B^{11} by deuterons. It is, therefore, almost certain that this γ ray arises from the decay of B^{12} to its ground state. Intensity measurements also indicate that this is the case. 16 references.

1546 The Distribution of Nuclear Charge in Fission. Lawrence E. Glendenin. M. I. T. Laboratory for Nuclear Science and Engineering Technical Report No. 35, July 29, 1949. 95p. (NP-1242.)

The principal aim of this investigation was to determine the most probable mode of division of nuclear charge in slow neutron-induced fission for a given mass split, and to derive a satisfactory distribution function for the variation of primary formation (or independent fission yield) with nuclear charge among fission products of the same mass number. It was shown that certain postulates of charge division could be eliminated on the basis of inconsistency with reliable experimental data on independent fission yields. Two postulates of charge division, however, were found to be in reasonable agreement with most of the experimental data available. One of these was derived empirically from experiment in the course of this investigation while the other was developed by Present (Phys. Rev. 72, 7(1947)) from theoretical considerations. Although the two postulates lead to somewhat different charge distribution curves, attempts to obtain critical data which would provide decisive evidence in favor of one or the other were without success. In the course of the experimental work the previously unobserved occurrence of shielded nuclides in slow neutron fission was demonstrated, and the formation of a radio-nuclide in appreciable yield through second order neutron capture by a stable fission product was discovered. In a detailed correlation of the charge distribution curves with noble gas sweeping data, it was shown that the major aspects of the gas sweeping experiments are fairly well explained by the ideas developed here on charge distribution in fission. Consideration of some anomalous independent yields observed in certain fission chains led to predictions of nuclear isomerism which were verified in subsequent work by other investigators. Finally, it was proposed that some anomalous fission yields which have been reported may be the result of perturbations caused by the closed shells of 50 and 82 neutrons.

The results of the experimental work may be summarized as follows. The fission yield of the shielded nuclide 34hr Br^{82} is 3.5×10^{-6}% corresponding to 1.75×10^{-4} of the total chain yield. The fission yield of the shielded nuclide 19.5d Rb^{86} is 3.1×10^{-5}% corresponding to 1.6×10^{-5} of the total chain yield. A 13d Cs activity found in low yield in the fission of both U^{235} and Pu^{239} was shown to be the shielded nuclide 13.7d Cs^{136} by production of this activity through the n,α reaction on La^{139}. Absorption and coincidence measurements showed

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that this nuclide decays by emission of 0.35-Mev β radiation followed by two γ-rays of 0.9 Mev in cascade; a hard β radiation of > 1 Mev energy is also present in low abundance (~ 1%). The fission yields of Cs^{136} from U^{235} and Pu^{239} are 0.0062% and 0.089% corresponding to the fractions 0.0010 and 0.015 of the total chain yields, respectively. Experiments on the shielded nuclide 5.4yr Eu^{154} showed that this activity is produced in considerable abundance in fission as the result of the second order neutron reaction on the stable fission product Eu^{153}. The observed yield of Eu^{154} corresponds to a pile neutron capture cross section of 1000 barns for Eu^{153}. In the experiments on independent yields along fission chains the independent yields of 54 min I^{134} and 22hr I^{133} were found to be 1.0% and 1.2% corresponding to the fractions 0.19 and 0.24 of the total chain yields, respectively. According to the charge distribution curves, the value for 22hr I^{133} appears to be too high and it is probable that nuclear isomerism exists in the parent Te^{133}. Although more experimental data will be required for a final decision between the two different but apparently satisfactory charge distribution curves based on Present's theory (ibid) and on the empirical rule of equal charge displacement, the work done in this thesis represents a major portion of experimental basis for the evaluation of any theory on the distribution of nuclear charge in fission. In future work the most valuable data will be obtained from further studies of the yields of shielded nuclides in the fission of Pu^{239} and U^{233} for which the average chain lengths are shorter than in U^{235} fission. It would also be of interest to check further on the possibility of fission yield perturbations by closed neutron shells and to study the change in the nature of charge distribution with increasing energy of the particle inducing fission. References included. (auth)

1547 Excitation Function of the Reaction $O^{18}(p,n)F^{18}$. J. P. Blaser, F. Boehm, P. Marmier, P. Preiswerk, and P. Scherrer. Helv. Phys. Acta 22, 598-9(1949) Dec. 1 (in French).

The isotope F^{18} may be produced by the reaction $O^{18}(p,n)F^{18}$. A strong source of this isotope was obtained by bombarding muscovite (a type of mica) with protons in a cyclotron. Thin, uniform sheets of mica may be used to measure the excitation function of the reaction by means of the method of superimposed sheets. A beam of protons from a cyclotron is made monoenergetic by means of a device which will be described elsewhere. This beam then falls on a pile of mica sheets, and the excitation curve may be determined from the activities of the individual sheets. The stopping power of the mica was compared, over various energy ranges, with that of aluminum and the energy of the beam in the various sheets was calculated using the equations of Bethe (Revs. Modern Phys. 9, 262(1937)). The excitation curve is plotted, and the following data is given for the six resonances which were found: proton energy, effective cross section, and excitation energy of the compound nucleus.

1548 Photo-electric Disintegration of the Deuteron at 6.13 and 17.6 Mev. C. A. Barnes, G. H. Stafford, and D. H. Wilkinson. Nature 165, 69-70(1950) Jan. 14 (Letter to the editor).

The cross section for the photo-electric disintegration of deuterons by γ rays with energies of 6.13 and 17.6 Mev was found to be: $\sigma_{6.13} = (21.5 \pm 1.2) \times 10^{-28}$ cm^2, $\sigma_{17.6} = (8.5 \pm 1.2)$

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$\times 10^{-28}$ cm^2. The disintegrations were produced in an ionization chamber of volume 475 cm containing deuterium at a pressure of 38 atm. The pulses from the resulting protons were analyzed by a 99 channel kick sorter. An identical chamber, filled with ordinary hydrogen was used to estimate the various background effects.

1549 Slow Neutron Capture in Helium. R. Batchelor, J. S. Eppstein, B. H. Flowers, and A. Whittaker. Atomic Energy Research Establishment Report No. AERE-N/R-278, nd. 9p.

The cross section for the reaction $He^3(n,p)H^3$ with thermal neutrons has been measured in atmospheric helium by means of a pulse-ionization chamber technique in which the disintegrations produced in the chamber are counted and the rate compared to the disintegration rate in argon containing a small admixture of nitrogen, in the same chamber and under identical conditions. The result obtained is $3{,}700 \times 10^{-24}$ cm^2 relative to the reaction $N^{14}(n,p)C^{14}$.

1550 High Energy Accelerators at the University of California Radiation Laboratory. Geoffrey F. Chew and Burton J. Moyer. UCRL-444, Sept. 9, 1949. 39p.

Three new accelerators at the Radiation Laboratory are described: the proton linear accelerator, the 184-in. synchrocyclotron, and the synchrotron. These have been in operation for less than three years. For each accelerator there are three main topics of interest: (1) the geometrical configuration which allows a particle to fall through a "potential difference," producing its final energy; (2) the focussing and stability characteristics of the beam; (3) the performance of the machine, that is, its capabilities as a research tool. 10 references.

1551 Operation of the 1/4 Scale Model Bevatron, V. E. J. Lofgren. UCRL-493, Oct. 25, 1949. 11p.

By the end of August most of the urgently required answers had been given by the 1/4 scale Bevatron and operations were reduced to one shift. By Oct. 18 regular operations were discontinued. During this final period the most important work was in connection with the new radio frequency system including the effect of radio frequency rise time. Measurements were made of the frequency of the betatron oscillations. Previously reported data such as the effect of tank pressure on beam were extended and improved. (auth)

1552 Theoretical Considerations in the Design of a Proton Synchrotron. A. A. Garren, R. L. Gluckstern, L. R. Henrich, and Lloyd Smith. UCRL-547, Dec. 9, 1949. 38p.

The theoretical treatment of several specific problems in the design of a proton synchrotron and calculated results obtained are presented. The first section, concerning injection, deals with two schemes for preventing the ions from striking the injector structure and with a system for focussing the incoming beam. The second section, concerning the orbits during the acceleration period, deals with certain effects of the straight sections, stray fields, magnetic inhomogeneities, resonant coupling between the various modes of oscillation, and with the damping effects introduced by the accelerating electrode.

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1553 The Synchrotron. B. F. Touschek. Acta Phys. Aust. 3, 146-55(1949) Dec. (in German).

The general principles on which a synchrotron operates are described. A comparison is made with other high energy machines such as the betatron and the cyclotron. The question of the stability of the orbits of particles in the synchrotron is discussed in some detail, as well as the energy loss of the particles due to radiation.

1554 Synchrotron Progress Report. Cornell University Floyd Newman Laboratory of Nuclear Studies, Nov. 1, 1949. 65p. (NP-1246.)

This report covers the work done on the Cornell synchrotron since Dec. 1947, specifically the details of construction, the tests made on the magnet, and the operation to date. Appendixes included.

1555 Absorption of Gamma-Rays in Aluminum. W. C. Parkinson. Phys. Rev. 76, 1348-52(1949) Nov. 1.

The scattering cross section for γ rays in aluminum was measured by two independent methods at the three energies 1.11, 1.71, and 2.76 Mev. The results 0.156, 0.125, and 0.0996 cm^{-1}, respectively, for the three energies are in agreement with the predictions of theory within the experimental error of $\pm 1\%$. The essential features of the measurement are: (1) Choice of γ-ray energies and absorbing material such that Compton scattering is the only important process. (2) Use of a geometry which effectively eliminates single and multiple scattering and permits an accurate determination of the background. (3) Elimination of errors due to the other γ-ray energies emitted by the source. (4) Determination of corrections for absorber impurities, counter deadtime, and random fluctuations in the counters and counter circuits. The two methods of measurement differ primarily in the way in which the errors due to the other γ rays emitted by the source are removed. 18 references.

1556 Inelastic Scattering of Deuterons. G. W. Greenlees, A. E. Kempton, and E. H. Rhoderick. Nature 164, 663-4(1949) Oct. 15 (Letter to the editor).

Recently performed experiments are described which indicate that deuterons are scattered inelastically by aluminum and magnesium targets. Such inelastic scattering is well known for protons but has not been observed before for deuterons. The deuterons used had a maximum energy of 6.7 Mev which could be reduced to less than 5 Mev by means of aluminum foils. The apparatus used was essentially like that described by Rhoderick (Nature 163, 848(1949)). Groups were observed which were prominent owing to their higher intensity; these have been attributed to deuterons which have suffered inelastic collisions. The Q-values calculated on this assumption are 0.85 and 2.13 for Al^{27} and 1.36 for Mg. These are in close agreement with the values deduced from the inelastic scattering of protons. To eliminate the possibility that the particles in question are protons formed in (d,p) reactions, further studies were made on the variation in the energy of the scattered particles with the energy of the incident deuterons and the angle of scattering. The results obtained indicate that the particles are deuterons. It is noted that the cross sections for these reactions seem to be very much the same as those for the corresponding proton reactions. In particular, the magnesium cross section is

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about five times those for aluminum, and is approximately equal to the cross section for elastic scattering from magnesium at a scattering angle of 110 deg.

1557 Multiple Compton Scattering II. W. R. Faust. Phys. Rev. 77, 227-32(1950) Jan. 15. (See also NSA 2-1167.)

An experimental and theoretical investigation has been made of the intensity and spectral distribution of γ radiation due to point and plane sources immersed in a homogeneous medium. The intensity is calculated by considering the multiple scattering as taking place in a succession of steps and the spatial distribution of the radiation is deduced from the equilibrium between quanta in a given group and those added to and removed from this group by scattering.

1558 Nuclear Shielding Studies. III. Shielding Properties of Various Materials Against Neutrons and Gamma Rays. John E. Dacey, Roger W. Paine, Jr., and Clark Goodman. M. I. T. Laboratory for Nuclear Science and Engineering Technical Report No. 23, Oct. 20, 1949. 219p. (NP-1243.)

Thermal and indium resonance (1.44 ev) neutron fluxes were determined with indium foils in Al and Cd holders and the γ-ray ionization intensity measured with pocket-type dosimeters, as functions of distance from a 1.03 gram Ra-Be source centrally located in a 4-ft cubical tank. The source was centered in 6-, 4-, and 2-in. radius spherical shells. Various combinations of the following materials were used in the experiments:

Materials in Spherical Shell		Media in Tank
Air	Water	Water
Lead	Boron carbide	Brine
Iron	Tungsten carbide	Sea water
Tungsten	Boron trioxide	Boric acid solutions
Sand	Boric acid	Boron trioxide
Brine		

Bothe's formula (Zeit F. Phys. 120, 1437(1943)) for the foil drain correction in thermal flux measurements was experimentally verified, and intercalibration with the standard flux at the Oak Ridge National Laboratory enabled neutron measurements to be expressed in absolute units. The strength of the 1.03-g source was determined to be 11.6×10^6 neutrons per second. A two-group analysis of this source, on the basis of Flugge's theory (Phys. Zeits. 44, 445(1943)), yielded: 5-Mev mean energy neutrons — 74% relative source strength; 200 kev mean energy neutrons — 26% relative source strength. The relaxation length, the mean square distance, the slowing-down distance, and the resonance escape probability were determined for various neutron distributions. Values for the thermal absorption cross sections of hydrogen and chlorine and for the thermal diffusion lengths in water and brine resulted from the diffusion data. There was no experimental evidence for neutron absorption other than 1/v in boron and chlorine. Estimates for average inelastic scattering cross sections of iron, lead, and tungsten were obtained by comparing the indium resonance distribution for air in the spherical shell with that for the inelastic scatterer in the shell. An upper limit for the mean effective energy of the inelastically scattered neutrons was established to be about 1 Mev. All results are in good agreement with

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generally accepted values reported in the literature. From the result of the γ ray measurements, approximations were made of the effective linear absorption coefficients of the aqueous media in the tank, and of the effective linear and mass absorption coefficients of the heavy shielding materials in the sphere. The rate of γ ray energy output of one gram of radium was determined to be 8.75 cal/hr, in good agreement with values obtained by other investigators. From this result, the absolute rate of decay of radium was calculated to be $(3.55 \pm 0.07) \times 10^{10}$ disintegrations/sec/g. The percentage of the total γ ray energy which escapes the various spherical shields was determined experimentally, and an empirical relation was developed for estimating the efficiency of a spherical γ ray shield of any arbitrary size and material. On the basis of human tolerance dosages of both γ rays and neutrons, minimum composite shields (weight and size) were determined. Of the materials tested the composite shields in order of relative effectiveness are: (1) tungsten-boric acid solution, (2) lead-boric acid solution, and (3) iron-boric acid solution. 87 references. (auth)

1559 Nuclear Shielding Studies. IV. Shielding Properties of the Concrete Wall of the M. I. T. Cyclotron. Victor Delano and Clark Goodman. M. I. T. Laboratory for Nuclear Science and Engineering Technical Report No. 24, May 19, 1949. 116p. (NP-1244.)

The shielding properties of the new 4-foot concrete wall of the M. I. T. cyclotron against neutrons and γ rays have been studied using foils for neutron detection and duPont 552 x-ray films for γ measurements. Fast neutrons were measured for thresholds of 4.5, 7.6, and 8.3 Mev by counting the β-active products of $Al^{27}(n,p)Mg^{27}$, $Fe^{56}(n,p)Mn^{56}$, and $Al^{27}(n,\alpha)Na^{24}$, respectively. Thermal activation was eliminated by Cd holders. Resonance (1.44 ev) and thermal neutron distributions, measured by Cd-In-Cd and In, with suitable corrections, were reduced to absolute intensities by comparison with a known flux. Measurements were made with cylindrical concrete blocks 2 in. and 4 in. in length which fitted into a $4\frac{1}{4}$ in. diameter hole whose axis was about 21.7 deg. with the direction of the deuteron beam at the cyclotron target and which extended through the concrete wall. Each block was recessed at one end to hold a foil or film. The results indicate an attenuation factor of 8.3 per foot for the fast neutron component and 10 per foot for thermal neutrons. An estimate of the fast neutron flux above 4.5 Mev showed a transmitted intensity higher than the presently accepted tolerance value. The absolute thermal neutron flux was below the tolerance level for these neutrons. The root-mean-square distance for thermal and resonance neutrons and the diffusion length in concrete were estimated by considering the distributed source to be equivalent to a point source at the inner face of the wall. The γ ray measurements were not convertible into roentgens. A mean energy of 2.7 Mev was obtained for the γ radiation within the wall. The attenuation factor for total γ radiation in the wall at large distances from the inner face was 5.9 per foot. 51 references. (auth)

1560 On the Back Diffusion of Fast Electrons. Walther Bothe. Z. Naturforsch. 4a, 542-5(1949) Oct. (in German). (See also NSA 4-1303.)

An investigation was made of the back diffusion of electrons with energies of 370 and 680 kev in C, Al, Cu, Sn, and

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Pb. The relative intensities and energy spectra of the back-scattered electrons was measured. Three graphs summarize the results.

1561 Scattering of Protons by Tritons. A. Hemmendinger, G. A. Jarvis, and R. F. Taschek. Phys. Rev. 76, 1137-41(1949) Oct. 15.

The proton-triton differential scattering cross section has been measured for laboratory angles between 45 and 135 deg. and proton energies between 0.7 and 2.5 Mev. In this angular range the scattering is predominantly nuclear and shows a rapid increase in intensity for angles greater than 90 deg. in the center of mass system. Some indications of anomalous behavior near the threshold for $T^3(p,n)He^3$ are reported. 19 references. (auth)

1562 Self-Absorption of S^{35} Radiation in Barium Sulfate. Frank C. Larson, Alfred R. Maass, Charles V. Robinson, and Edgar S. Gordon. Anal. Chem. 21, 1206-7(1949) Oct.

A description is given of a technique developed for the collection of radioactive precipitates utilizing centrifuge tubes with removable flat bottoms. A study of the self-absorption of S^{35} activity in barium sulfate is reported. A value of 0.216 cm^2/mg was found for the self-absorption coefficient of S^{35} in barium sulfate on a Lusteroid backing. 10 references.

1563 Half-Life of Pa^{232}. Arthur H. Jaffey and Earl K. Hyde. AECD-2794, Jan. 1948, decl. Jan. 24, 1950. 9p.

The half-life of Pa^{232} has been measured on samples of Pa^{232} prepared by two different reactions: by $Th^{232}(d, 2n)Pa^{232}$ and by $Pa^{231}(n, \gamma)Pa^{232}$. The half-lives for Pa^{232} formed by the two reactions were respectively 32.3 ± 0.4 and 31.2 ± 0.2 hr. The half-lives were determined only incidentally in the course of other experiments and are of but limited accuracy. However, they are being reported here because values of greater accuracy have not as yet been published. Both samples of Pa^{232} had long-lived contaminants, which had to be subtracted in order to get the desired half-life.

1564 The Electrical Charge of 18-Min Br^{80} from Isomeric Transition. S. Wexler and T. H. Davies. AECU-597 (UAC-142), nd. 10p.

The isomeric transition of 4.4-hr Br^{80*} to 18-min Br^{80} seems to occur by an internal conversion process. De-excitation of the nucleus by emission of a K (or L) electron will leave the atom or molecule in an electronically excited state. An "Auger process" should follow in which the cascade of electrons toward the vacancy produces ionization of additional electrons as well as x-radiation. Thus, according to calculations, the transformed nucleus may have a positive charge. This paper describes the effect of an electric field upon the distribution between electrodes of Br^{80} from Br^{80*} present as gaseous C_2H_5Br. From the data obtained in this experiment the distribution of Br^{80} among species of positive, negative, and no charge is estimated.

1565 Final Report on Capture Gamma Ray Experiments Using Portable Neutron Sources and Coincidence Counting. Edgar C. Barker and J. F. Coneybear. NEPA-1231, Dec. 12, 1949. 17p.

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It has been suggested that information concerning capture γ rays (those γ rays emitted immediately following neutron capture) might be obtained utilizing neutrons from a Polonium-Beryllium (Po-Be) source. Since a 1 curie source produces about 3×10^6 neutrons per second, it appeared that a large Po-Be source would provide enough neutrons for a study of the capture γ rays from various absorbing materials. The outline of a typical capture γ measurement is as follows: (1) a target of the material to be studied is placed in the flux of thermalized neutrons from a Po-Be source; (2) the capture γ rays produce electrons in a radiator by photoelectric, Compton, or pair production processes; (3) the energy of these secondary electrons is measured by taking coincidence absorption measurements using aluminum absorbers and knowing the range vs energy relationship for secondary electrons. From the experimental data obtained, it is concluded that using a Po-Be source and coincidence counting, one cannot sufficiently discriminate against the γ rays produced in the source to determine experimentally the maximum energy of capture γ rays or their distribution in energy. The studies have been discontinued.

1566 Neutron Deficient Isotopes of Iodine. Luis Marquez and I. Perlman. UCRL-555, Dec. 29, 1949. 10p.

The iodine isotopes I^{123}, I^{122}, I^{121}, and I^{120} (?) have been made by bombarding antimony with α particles and evidence for mass assignments is presented. Their characteristics are summarized as follows:

Mass No.	Half-life	Radiation	Energy
124	4.5 days	K, β^+	β^+ = 2.1 ± 0.1 Mev
123	13 hr	K, γ, e^-	e^- = 150 ± 15 kev
122	4 min	β^+(K, γ ?)	β^+ = 2.9 ± 0.1 Mev
121	1.8 hr	K, β^+, γ, e^-	e^- = 185 ± 10 kev
			β^+ = 1.2 ± 0.1 Mev
120?	~30 min	β^+, γ(K?)	β^+ = 4.0 ± 0.2 Mev

1567 Angular Distribution of $\gamma\gamma$ Coincidences in In^{111}. F. Boehm and M. Walter. Helv. Phys. Acta 22, 378-80 (1949) Aug. (In German).

In^{111} (2.7 days) decays through K-capture into Cd^{111} which passes into its ground state after emission of two successive γ quanta of 173 and 247 kev. The ground-state nuclear spin was found spectroscopically to be equal to 1/2. As to the spin values of the excited states, Hamilton (Phys. Rev. 58, 122(1941)) has shown that they can be determined if the multipole character of the radiations and their angular correlation are known. The authors measured the correlation by counting coincidences of the two γ radiations at the angles π, $\pm\frac{\pi}{2}$, and $\pm\frac{3\pi}{4}$. Using as a distribution function $1 + A\cos\alpha$, the anisotropy found was $A = -0.07 \pm 0.04$. Assuming further, with the most reliable sources, that the 173 kev quantum is a magnetic dipole, while the 247 kev quantum is an electric quadrupole, it is found that the spins of the excited Cd^{111} levels are 5/2 and 3/2 if $A = -0.07$, or 7/2 and 5/2 if $A = -0.10$.

1568 Assignment and Characteristic Radiations of the 14-day Tin Activity. E. C. Mallary and M. L. Pool. Phys. Rev. 77, 75-6(1950) Jan. 1.

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The tin isotope which decays with a 14-day half-life by an isomeric transition is definitely assigned to mass number 117. It was produced by the reactions $Cd^{114}(\alpha,n)$, $Sn^{116}(d,p)$, $Sn^{118}(n^f,2n)$ and $Sn^{117}(n^f,n)$, and by the decay of indium 117 which is produced by the reaction $Cd^{116}(d,n)$. The cross section of the reaction $Sn^{117}(n^f,n)$ is about 1.8 times larger than the cross section of the reaction $Sn^{118}(n^f,2n)$. Characteristic reactions are K and L conversion electrons of 0.146-Mev and 0.171-Mev energy, respectively, tin x-rays, and 0.175-Mev γ rays which are about 50% internally converted.

1569 Assignment and Disintegration Scheme of the 6.75-hour Molybdenum. D. N. Kundu, John L. Hult, and M. L. Pool. Phys. Rev. 77, 71-4(1950) Jan. 1.

Contrary to previous reports (Kundu and Pool, Phys. Rev. 76, 183(1949)), deuteron bombardment of molybdenum does not produce any measurable amount of the 6.75-hr Mo activity. The assignment of this activity has, therefore, been reinvestigated and correctly found to be still Mo^{99}. Decay does not take place by positron emission or K-capture. A disintegration scheme has been worked out using absorption, β-ray spectrograph, and coincidence counter measurements. By successive emission of three γ rays of energies 0.30, 0.70, and 1.7 Mev of which the first is about 90% internally converted, the 6.75-hr Mo^{99} passes into a long-lived isomeric state. Mo K_α x-rays resulting from the conversion have been found. (auth)

1570 The Beta-Decay of B^{12} and Li^8. W. F. Hornyak and T. Lauritsen. Phys. Rev. 77, 160-4(1950) Jan. 15. (See also NSA 2-622.)

The electron spectra of B^{12} and Li^8 have been studied, using a magnetic lens spectrometer. The end point of the B^{12} distribution is 13.43 ± 0.06 Mev, while the Li^8 spectrum tails off gradually with a shape which is consistent with the known broadness of the excited state of Be^8 to which the decay occurs. Neither distribution corresponds to the shape indicated for simple "allowed" transitions, but it seems probable that more than one state of the residual nuclei may be involved in the decay schemes. The discrepancy between the observed end point of the B^{12} spectrum and the mass differences suggests the existence of an excited state at 0.9 Mev either in B^{12} or C^{12}. The subject matter in this article was first set forth in a letter to the editor Phys. Rev. 74, 1727(1948) Dec. 1.

1571 Beta Spectrum of Au^{198}. B. S. Dzhelepov, A. A. Bashilov, A. V. Zolotavin, and N. M. Anton'eva. Doklady Akad. Nauk. S.S.S.R. 64, 803-5(1949)(in Russian).

By irradiating a gold foil with neutrons, the internal conversion in Au^{198} (2.7 days) was investigated with a new magnetic spectrometer, in which ϕ = 30 deg., ρ = 8 cm, $\Delta\rho/\rho$ = 1%. The calibration was done with the aid of Ra(B + C). The γ quantum of the internal conversion is 410 ± 4 kev. Curves are given showing the continuous β spectrum and the three maxima corresponding to conversion at the levels K, L, and M. The β end point is at 955 ± 10 kev; if there exists a soft component of 605 kev, its intensity cannot exceed 15% of the main one. The distance between the maxima K and L is equal to 68 kev, that between the maxima L and M is 11 kev. The conversion coefficients for the three maxima K, L, and M + N are, respectively, 2.6, 1.2, 0.3%. No other maxima were found in the range 250-1000 kev.

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1572 Beta-Spectrum of Be^{10}. P. R. Bell and J. M. Cassidy. Phys. Rev. 77, 301(1950) Jan. 15 (Letter to the editor).

The scintillation spectrometer (Bell, et al, Phys. Rev. 76, 574(1949)) has been used to determine the β spectrum of Be^{10}. The sample was made by activating Be in the Oak Ridge pile and then enriching the sample in Be^{10} by magnetic separation at Y-12. The results obtained confirm the earlier result reported at the 1949 Washington meeting of the Physical Society. The Kurie plot, with second forbidden tensor correction, is linear and indicates an energy upper limit of 0.535 Mev, in good agreement with other recent measurements (Wu and Feldman, Phys. Rev. 76, 698(1949); Fulbright and Milton, ibid., 1271(1949)).

1573 The Beta-Spectrum of Ca^{45}. P. Macklin, L. Feldman, L. Lidofsky, and C. S. Wu. Phys. Rev. 77, 137-8 (1950) Jan. 1 (Letter to the editor).

A sample of Ca^{45}, received from the AEC at Oak Ridge was used to investigate the upper energy region of the β spectrum of this isotope. Several sources of thickness varying from 200-450 $\mu g/cm^2$ were prepared on collodion backing and the spectrum was examined with a magnetic solenoidal spectrometer. The end point of the spectrum as extrapolated from the Fermi plot was found to be 254 ± 3 kev. In constructing the Fermi plot the nonrelativistic coulomb factor was used. Such a plot is reproduced and is seen to be straight from the end point to 90 kev. Deviations below this energy are attributed to the finite thickness of the source. Although the Fermi plot is linear, it is noted that the transition is forbidden.

1574 Betatron-Produced Sources of High Specific Activity: Copper 62. R. A. Becker, F. S. Kirn, and W. L. Buck. Phys. Rev. 76, 1406-7(1949) Nov. 1 (Letter to the editor).

Specific activities of more than 5 mc of Cu^{62} positron activity/g were obtained by bombarding metal foils with a 22-Mev betatron. The electron beam was made to strike a lead converter, the resulting x-rays in turn activating the foil. The γ cross sections are much larger than electron cross sections. Therefore, the specific activities obtained were more than 1,000 times greater than those obtained in a conventional manner with an x-ray doughnut. The Cu^{62} positron spectrum was measured with a 180-deg. spectrometer. Its end point was determined as 2.83 ± 0.05 Mev. A Kurie plot is given.

1575 Contribution to the Study of the Radioactivity of Samarium. Ch. Haenny, M. Najar, and M. Gailloud. Helv. Phys. Acta 22, 611-14(1949) Dec. 1 (in French).

Many authors have noted the presence of a group of long-range particles associated with the α particles emitted by Sm^{152}. It has been shown that the range of these particles is the same as the range of the α particles emitted by Po, and they have, therefore, been attributed to impurities in the Sm. In the experiments described in this article, photographic plates were loaded with samarium acetate, and it was found that the relative number of long-range tracks depended on the source of the samarium salt. Plates were then loaded with salts of RaD, and the tracks examined were very similar to the long range tracks produced by samarium acetate. The author, therefore, concludes that the tracks are, in fact, produced by impurities in the samarium. Range measurements are in good agreement with the results previously reported.

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1576 Conversion Electrons of Radium D. Lawrence Cranberg. Phys. Rev. 77, 155-9(1950) Jan. 15.

The conversion electrons of radium D (Pb^{210}) have been studied with thin sources on thin backings in a β-ray spectrograph using calibrated photographic emulsions. The number of conversion electrons due to the 47-kev γ ray has been measured to be 74 ± 5 per hundred disintegrations. The L:M:N ratio is 1:0.26:0.077. This implies a complex decay scheme for radium D, since earlier results give 3.5 unconverted 47-kev γ rays per hundred disintegrations.

1577 The Disintegration of Ag^{110}. Kai Siegbahn. Phys. Rev. 77, 233-8(1950) Jan. 15.

The disintegration of Ag^{110} has been investigated using spectrometer and coincidence technique. The radiation contains a great number of β and γ components and the disintegration scheme is complicated. Four β components and 10 γ rays have been found and their energies and intensities measured. The 225-day activity is due to an isomeric level in Ag, separated 116-kev from the 24-sec ground level. The internal conversion coefficient of the γ ray at 656 kev has been determined to be 2.5 ± 10^{-3} by means of coincidence spectrometry. The disintegration scheme is discussed. (auth)

1578 Disintegration of Hg^{203}. Hilding Slätis and Kai Siegbahn. Arkiv Mat. Astron. Fysik 36 A, No. 21 (1949) 11p.

Investigations of the decay of Hg^{203} which have been reported on briefly elsewhere (Phys. Rev. 75, 318(1949)) are described in greater detail. The β and γ radiations were studied by means of absorption measurements, magnetic spectrometers and β-γ coincidence measurements. The upper limit of the β spectrum was found to be 208 kev and the energy of the γ ray, 279 ± 2 kev, in agreement with Saxon's values. The lines observed for conversion electrons and for photoelectrons are noted and the internal conversion coefficient is estimated as 27%. On the basis of these data, a decay scheme is proposed. It is noted that the disintegration of Hg^{203} leads to the same excited level of 279 kev energy in Tl as the K capture by Pb (52 hr). The mass assignment for Hg(43.5 d) is 203, which, therefore, has to be assumed also for 52-hr Pb.

1579 Energy of an Excited State of Li^7. Michel Ter-Pogossian, J. Eugene Robinson, and C. Harold Goddard. Phys. Rev. 76, 1407-8(1949) Nov. 1 (Letter to the editor).

To test the hypothesis of Primakoff and Feenberg (unpublished) concerning the existence of two closely spaced excited states of Li^7, the energy of the radiation emitted in the transition $Li^{7*} \rightarrow Li^7$ was measured for Li^{7*} produced in the reaction $Be^7 \rightarrow Li^{7*}$, by comparing it with the energy of the β radiation emitted by Au^{198}. The energy of the excited state of Li^7 was found to be 478.5 ± 0.5 kev, which may be compared with the energy of the excited state of Li^7 following upon the reaction $B^{10}(n,\alpha)Li^{7*}$, reported by Elliot and Bell (Phys. Rev. 74, 1869(1948)) as 478.5 ± 1.5 kev. It appears that the two excited states, if different, are not separated by more than 2 kev.

1580 An Examination of Praseodymium, Neodymium, and Samarium for α-Activity. F. Bestenreiner and E. Broda. Nature 164, 658-60(1949) Oct. 15 (Letter to the editor).

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Praseodymium, neodymium, and samarium have been studied using the photographic method recently described (Nature 164, 412(1949)) for the detection of extremely weak α activities. Approximate values of 2.6×10^{14} year, $> 1.3 \times 10^{15}$ year, and 1.2×10^{14} year were obtained for the half-lives for α decay of Nd, Pr, and Sm, respectively (assuming that α decay occurs). The bearing of the results on the question of whether an unidentified pleochroic halo of a certain type, found in very old mica, is due to an α-active isotope of Pm (Schintlmeister, Wiener Berichte 144, 475(1935); 145, 449(1936)), is discussed. Reasons against assigning the unidentified pleochroic halo of radius 1.8 cm air-equivalent to Pm are given. If, however, the assignment is true, it would have to be assumed that the species is short-lived and is, or was, replenished from a long-lived source.

1581 Fine Structure of the Magnetic Alpha Spectrum of Thorium X. Salomon Rosenblum, Manuel Valadares, Marguerite Perey, and Jeannine Vial. Compt. rend. 229, 1009-11(1949) Nov. 14 (in French).

In a previous article on the spectrum of the radiation emitted Th^{228} + Ra^{224} (ThX) (Rosenblum et al, Compt. rend. 228, 385(1949)), the existence of a fine structure in the magnetic alpha spectrum of ThX was indicated. The previous experiments have been repeated using almost pure samples of ThX, separated from a Th^{228} source by a method described in detail. A plot of the spectrum is given and it is seen to consist of three components. The energy of one of the components has already been determined (Proc. Roy. Soc. (London) 238, 638(1933)). The other energies may be calculated from this value. It is found that the intensities of the different components are in good agreement with the theory of Gamow.

1582 Lifetimes of Excited States of Au^{197}, Fe^{57}, Cd^{111}, Hg^{198}, and Tl^{203}. Martin Deutsch and W. E. Wright. Phys. Rev. 77, 139-40(1950) Jan. 1 (Letter to the editor).

The method of delayed coincidences has been applied to the measurement of nuclear lifetimes between 5×10^{-9} sec and 1×10^{-6} sec. Scintillation counters using stilbene or anthracene with RCA 5819 photomultiplier tubes were used with wide band amplifiers of a design due to Elmore and a fast electronic coincidence circuit. Beta-beta, beta-gamma, and gamma-gamma coincidences were studied. In most cases the lifetimes were so short that only upper limits could be set. The results are tabulated and compared with those of previous experiments.

1583 New Determination of the Fine Structure of the α Spectra of Radium. Salomon Rosenblum, Marcel Guillot, and Geneviève Bastin-Scoffier. Compt. rend. 229, 191-3(1949) July 18 (in French).

Recent work (Chang, Phys. Rev. 70, 632(1946)) has indicated the existence of new groups of very low intensity in the α spectrum of radium. This spectrum has been studied again by the usual method which permits the use of very low intensity sources and furnishes very fine lines. The time of exposure was varied from one to five days. Although the results are not certain, a group which might be the one observed by Chang is noted on the curve at 600 kev. The intensity of the group is about 2% of the intensity of the group having the highest intensity. This is in agreement with the predictions of Gamow's theory (Constitution of atomic nuclei and radioactivity, 1931).

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1584 Note on the Radiations and Isotopic Assignment of the 50-Year Radioelement 94. N. Feather. Br-48A, nd. 8p.

This paper is concerned with the mass assignment of the 50-yr α-active plutonium isotope produced by bombarding uranium with high energy deuterons. The author concludes that the results he obtained favor the assignment of a mass number of 238 to this isotope instead of 235 which had been proposed as an alternative assignment.

1585 Nuclear Gamma-Radiation of Cu^{61}. F. Boehm, J. P. Blaser, P. Marmier, and P. Preiswerk. Phys. Rev. 77, 295-6(1950) Jan. 15 (Letter to the editor).

The positron spectrum of Cu^{61} has been examined recently by Cook and Langer (Phys. Rev. 77, 227(1948)) with a large magnetic spectrometer. The experimental curves of these authors show a deviation from the Fermi distribution which is much larger than for Cu^{64} and it seems possible that not all of this deviation arises from instrumental factors. In order to determine whether these deviations might be due to the emission of nuclear γ rays, a search was conducted for conversion electrons and photoelectrons in the radiation of this isotope. Three γ rays were found and their energies and relative intensities are given. The presence of these γ rays satisfactorily explains the form of the positron spectrum.

1586 On the α - β- and α - K-Branching of the Heaviest Natural and Artificial Radioactive Substances. W. Jentschke. Phys. Rev. 77, 98-101(1950) Jan. 1.

Based on simple empirical regularities in α-decay properties of the heavy elements, the following substances which show β emission or K capture should also be α radioactive with α - β- or α - K-branching ratios of at least 10^{-10}: $MsTh_2$, $MsTh_1$, AcK; Ra^{225}, Pa^{233}, Np^{234}, Np^{235}, Np^{236}, Np^{238}, Np^{239}, Pu^{241}, Am^{242}. (auth)

1587 On the β Decay of H^3. M. E. Vol'khanskiĭ, B. S. Dzhelepov, and L. A. Sliv. Doklady Akad. Nauk S. S. S. R. 66, 829-32(1949)(in Russian).

Among the β^+ emitters, nuclei $M_Z^{2Z\pm1}$ belong to the group of mirror nuclei, for which one of the authors (Dzhelepov, Doklady Akad. Nauk S. S. S. R. 62, 51(1948)) has established the following rules: (1) β decays are always permitted, (2) the products τf deviate little from the mean 3,500. In the present work the problem of the existence and properties of mirror nuclei among β^- emitters is investigated, the case studied being that of H^3. The calculation of τf presents in this case certain peculiarities: the upper limit of the β spectrum being relatively small, the question of the mass of the neutrino becomes important; the small values of the energies of the β particles necessitate the introduction of the coulomb factor. The calculation shows that the case under study satisfies the rules established for the mirror nuclei. It can thus be said, in a general way, that the nuclei $M_Z^{2Z\pm1}$ form a compact group of permitted β emitters. The current theory seems to explain satisfactorily the properties of these emitters, whose half life periods vary from 1 to 4×10^9 sec and the upper energy limits of the β spectrum occupy a range from 18 to 5,000 kev.

1588 On the Theoretical Evaluation of the Ratio of the Nuclear Capture Probabilities of the K and L_1 Electrons of A^{37}. Pierrette Benoist and Maurice Jean. Compt. rend. 228, 1848-50(1949) June 13 (in French).

An appreciable discrepancy between the experimental and theoretical ratios obtained for the nuclear capture probabilities of K and L_1 electrons of A^{37} has been observed by Pontecorvo, et al,(Phys. Rev. 75, 982(1949)), which they blamed on the experimental difficulties. The authors indicate a source of error in the theoretical calculations which could be responsible for the disagreement, i.e., the introduction of an effective Z, characteristic of the electronic layer considered, into the hydrogen functions used. It is noted that when the nonrelativistic approximation suffices, it is possible to use the wave-functions calculated by Hartree and obtain a good agreement between the experimental and theoretical values of the ratio.

1589 Photo-Disintegration of Rhodium. N. W. Curtis, J. Hornbostel, D. W. Lee, and E. O. Salant. Phys. Rev. 77, 290-1(1950) Jan. 15 (Letter to the editor).

Angular and energy distributions of protons from nuclei disintegrated by collimated x-rays produced by a 20-Mev betatron have been studied, and some preliminary results are given for the disintegration of rhodium. Particles leaving the rhodium target were recorded by means of Ilford plates placed behind the target. The energy distribution of the emitted protons is plotted for three different emission angles, and the ratio of the small-angle to the right-angle intensity is given for several proton energies. It is seen that right-angle emission predominates over small-angle emission, particularly at high-proton energies. The cross section for right-angle emission is plotted as a function of the γ-ray energy, and the total cross section for right-angle emission with a γ-ray energy of 17.5 Mev is given as 3.6×10^{-28} cm^2/sterad.

1590 The Physical Properties of Polonium. III. The Half-Life of Polonium. William H. Beamer and William E. Easton. J. Chem. Phys. 17, 1298-1300(1949) Dec.

The half-life of polonium has been measured by a calorimetric method. The reproducibility and precision of the data is much greater than has been previously reported. The value is found to be 138.3 ± 0.1% days.

1591 The Range of the α-Particles from Thorium. H. Korsching. Z. Naturforsch. 4a, 563(1949) Oct. (Note, in German).

The range of α particles from Th^{232} in Ilford B1 plates was found to be 15.15 ± 0.2 μ. This corresponds to a range in air 15°C and 760 mm Hg of 2.5 cm.

1592 Search for Photons Emitted by Long-Life Species of Nickel. D. G. Thomas and J. D. Kurbatov. Phys. Rev. 77, 151-2(1950) Jan. 1 (Letter to the editor).

A study was made of the long-life photon activity of a nickel sample activated at Oak Ridge. To secure low background, the active nickel was shielded and the emitted radiation was collimated. The work was done with a Geiger counter and a cloud chamber. The photons observed are listed in order of intensity: 7.5, 15, 38, and 80 kev, and the intensity ratio is given as 6:1:1:1. Tracks in the chamber revealed the presence of monochromatic electron groups. No evidence was found for the existence of excited states of Co^{59} and Cu^{63}, which are the decay products of Ni^{59} and Ni^{63}, respectively.

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1593 A 7×10^{-9} sec Isomeric State in $_{79}Au^{197}$. F. K. McGowan. Phys. Rev. 77, 138-9(1950) Jan. 1 (Letter to the editor).

The author has studied the isomeric state of Au^{197} produced by the decay of Hg^{197}, by means of a delayed coincidence technique described in a previous letter (Phys. Rev. 76, 1730 (1949)). The delayed coincidences are plotted as a function of the delay time and the half-life is given. A delayed coincidence scintillation spectrometer is being used to study the radiation spectra preceding and following the formation of the isomeric state. The results will be reported later.

1594 Study of the Electronic Radiation of Ionium by the Photographic Plate Method. Georgette Albouy, Henriette Faraggi, Michel Riou, and Jean Teillac. Compt. rend. 229, 435-6(1949) August 17 (in French).

The β radiation of Io is due chiefly to the internal conversion of the 68 kev quantum in the L_1 level, and consists mainly of monoenergetic electrons of 48 kev. Already studied by one of the authors (Teillac, Compt. rend. 227, 1227(1948)), this radiation is here measured with the aid of the new Ilford, Nuclear Research G5, plates (200 μ), sensitive to individual electron trajectories. The plates were impregnated in 80 cm^3 of a 5% acetic acid solution containing 3×10^{-6} g Io + Th nitrate; they were developed four days later. The measurement of about 3,000 α tracks attributable to Io showed a 18.81 μ mean range, corresponding to a stopping power of the plates equal to 1,660. The number of electron tracks having a common origin with the α was about ten times smaller than the number of α tracks. This result, (10 electrons per 100 disintegrations), disagrees with the determinations of the number of 68 kev quanta, (0.6 per 100 disintegrations), and of the number of excited states of the 68 kev nuclear level, (25 per 100 disintegrations), found by several authors (Curie, Compt. rend. 227, 1225(1948); Riou, Compt. rend. 228, 678(1949); Rosenblum et al, Compt. rend. 227, 1088(1948)). The mean range of the electrons was 12.5 μ, corresponding to a stopping power 3,200. The mean number of grains was 9 ± 1.

1595 Concerning the Integration of the Perturbed Time-dependent Schroedinger Equation. H. Kallmann and M. Päsler. Z. Physik 126, 749-59(1949)(in German).

In the previous treatment of wave mechanical perturbation problems by the authors (Z. Physik 126, 734(1949)) by means of the Laplace transform only the time-independent Schroedinger equation was considered, and the perturbation function was assumed to consist of a sum of terms proportional to nonlinear powers of the variables occurring in the Schroedinger equation. These restrictive assumptions are here dropped, and a general treatment is given of time-dependent perturbation theory by means of the Laplace transform.

1596 The Conservation Laws in Dirac's Theory. Yu. A. Starikin. Zhur. Ekspti. i Teoret. Fiz. 19, 749-752 ; (1949)(in Russian).

Rumer (Zhur. Ekspti. i Teoret. Fiz. 19, 86, 207(1949)) has given a general field theory called "five-dimensional optics" (or "5-optics"). The present author develops this theory by deriving from it the laws of conservation of energy, momentum, and charge of Dirac's theory. These laws

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are derived by applying the variational principle, in analogy with the procedure that has been used for the tensor equations of the gravitation theory and the electrodynamics. Besides the classical transitions of energy and momentum from matter to field, and vice versa, the 5-optics describes similar transitions of charge.

1597 Field Dynamics. I. Classical. K. V. Roberts. Phys. Rev. 77, 146(1950) Jan. 1 (Letter to the editor).

The interaction representation has been derived from the noncovariant Heisenberg-Pauli treatment via the Heisenberg representation, but the author considers this derivation unsatisfactory. In this paper the interaction Hamiltonian is derived by a classical method. The classical approach of Weiss (Proc. Roy. Soc. 169, 102(1938)) is applied and his work extended. It has already been pointed out that this approach leads to shorter calculations (Matthews, Phys. Rev. 75, 1270(1949)).

1598 Field Dynamics. II. Quantum. K. V. Roberts. Phys. Rev. 77, 146-7(1950) Jan. 1 (Letter to the editor).

Using the results of section I of this letter (Phys. Rev. 77, 146(1950)), the author makes the transition to quantum theory, deriving the quantum mechanical interaction representation.

1599 Field-Mechanical Wave Equations for Elementary Particles with Various Spins. Fritz Bopp and Friedrich L. Bauer. Z. Naturforsch. 4a, 611-25 (1949) Nov. (in German).

It is assumed that the spin of a charged particle is due to the interaction of the particle with its own field. Quantum-mechanically spin is considered a result of emission and reabsorption processes which can produce charge rotation about a center outside the particle and thus a dipole moment. In a previous derivation of the Dirac equation on the basis of these assumptions (Bopp, Z. Naturforsch. 3a, 564(1948)), this motion was identified with the "Zitterbewegung" found by Schroedinger as a solution of the Dirac equation. Here this identification is dropped, and a more general derivation yields equations similar to that of Dirac valid for particles with higher spin. These equations are essentially similar to those derived in a different way by Madhavarao et al (Proc. Roy. Soc. (London) 187A, 385(1946)), Bhabha (Rev. Modern Phys. 17, 200(1945)), and de Broglie (Théorie générale des particules à spin, Paris, 1943).

1600 Formulas and Theorems for the Special Functions of Mathematical Physics. Wilhelm Magnus and Fritz Oberhettinger, translated from the German by John Wermer. New York, Chelsea Publishing Co., 1949. 172p.

This book contains an extensive set of formulas and theorems, given without proof, for the following functions of mathematical physics: gamma functions, cylindrical functions, spherical harmonics, orthogonal polynomials, confluent hypergeometric functions, theta functions, elliptic functions and integrals. Integral transformations are described, and comprehensive tables of Fourier and Laplace transforms are given. Formulas relevant to coordinate transformations are listed. Finally, a bibliography refers

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the reader to the literature where proofs of all the results mentioned may be found.

1601 Interaction Energy of Relativistic Particles in Second Approximation with Respect to the Charge. Zh. S. Takibaev. Zhur. Eksptl. i Teoret. Fiz. 19, 680-7(1949)(in Russian).

In the framework of the classical electrodynamics, the system of two interacting relativistic particles is examined, the interaction energy being expressed as a power series of the charge. A formula is obtained for that part of the interaction energy which is proportional to the product of the charges of the two particles; thus, the formula is analogous to that of Møller in quantum mechanics. By introducing a different time for each particle, it is possible to obtain the whole series, that represents the interaction energy, in a form symmetrical with respect to the coordinates and the velocities of both particles. The same problem is then treated by the Hamilton-Jacobi method, with the aid of the classical perturbation theory developed by Markov (Zhur. Eksptl. i Teoret. Fiz. 18, 510(1948)).

1602 Laws of Probability, Equations of Hydrodynamics and Quantum Mechanics. Jean Bass. Rev. sci. 86, 643-52(1948) Nov. (in French).

The author compares quantum mechanics with classical statistical mechanics using the formalism of the theory of mixtures of states. The connection between the two theories is made by way of a "pseudo-density of probability" f used for the first time by Wigner (Phys. Rev. 40, 749(1932)). This function is a probability density for the position-momentum variables of statistical mechanics, and it may be shown that average values for all physical variables connected with the system may be derived from it. The time variation of the function f is determined by an equation equivalent to Schroedinger's equation, and it is possible to establish a hydrodynamical analogy to describe the flow of the function in configuration space.

1603 On Invariant Commutation Relations and the Exclusion of Supplementary Conditions in the Quantum Theory of the Meson Field. E. M. Lipmanov. Doklady Akad. Nauk 67, 627-30(1949)(in Russian).

In the quantization procedure given by Heisenberg and Pauli (Z. Physik 56, 1(1929)), the Fourier amplitudes of the wave function are considered as operators following "canonical" quantum conditions. When applied to vector fields, this procedure should be a quantization of the vector components as independent scalars. Actually, however, the latter are not independent, being tied together by a certain supplementary condition, which, in quantum theory, contradicts the "canonical" commutation relation. By introducing special operators, it is possible, without changing the form of the Hamiltonian of the field, to represent the commutation relation of the new operators in the "canonical form." This formulation of the theory permits the application of Dirac's radiation equations to transverse and longitudinal mesons.

1604 On the Pair Theory of Nuclear Forces. Yu. Lomsadze and M. Markov. Zhur. Eksptl. i Teoret. Fiz. 19, 178-80(1949)(in Russian).

The recent discovery of neutral mesons in cosmic radiation motivated this theoretical study on nuclear forces involving such neutral particles. It is assumed that the interaction field is composed of neutral mesons, whose distribution obeys the Fermi statistics, that they all have the same rest mass $\sim 200\ m_e$, and that Dirac's equations describing a spin 1/2 is applicable to them. The investigation follows the two known variants of the theory of β decay, that of Fermi and that of Uhlenbeck and Konopinski, the physical picture being, correspondingly, a simultaneous emission (1) of a pair of particles (electron and neutrino), and (2) of a particle and an antiparticle (electron and antineutrino). After an examination limited to the vector function of the interaction between two nucleons, a general theory, in the nonrelativistic approximation for nucleons, is given. It is shown that the neutretto and the antineutretto furnish different laws of interaction in a pair theory of nuclear forces.

1605 On the Treatment of Quantum Electrodynamics without Eliminating the Longitudinal Field. Ning Hu. Phys. Rev. 77, 150(1950) Jan. 1 (Letter to the editor). (See also NSA 3-1495.)

Several points in a previous paper (Phys. Rev. 76, 391 (1949)) are clarified. It is noted that one of the derivations is incomplete, and a different derivation is given. Two important misprints and misstatements are also noted.

1606 Quantum Theory of Non-Local Fields. Part I. Free Fields. Hideki Yukawa. Phys. Rev. 77, 219-26 (1950) Jan. 15.

The possibility of a theory of nonlocal fields, which is free from the restriction that field quantities are always point functions in the ordinary space, is investigated. Certain types of nonlocal fields, each satisfying a set of mutually compatible commutation relations, which can be obtained by extending familiar field equations for local fields in conformity with the principle of reciprocity, are considered in detail. Thus a scalar nonlocal field is obtained, which represents an assembly of particles with the mass, radius and spin 0, provided that the field is quantized according to the procedure similar to the method of second quantization in the usual field theory. Nonlocal vector and spinor fields corresponding to assemblies of particles with the finite radius and the spins 1 and ½, respectively, are obtained in the similar way.

1607 Scattering by a Nuclear Potential. Lajos Jánossy and James McConnell. Proc. Roy. Irish Acad. 52A, 203-22(1949) Sept.

When the Born approximation is applied to high energy collisions of particles with meson interaction, the effects of radiation damping must often be taken into account to give cross sections of the correct order of magnitude. However, problems involving radiation damping are difficult or impossible to solve. In this paper the Born approximation is analyzed with a view to determining the limitations of the approximation when radiation damping is neglected and the effects of the damping terms and the higher order terms which arise in the perturbation theory.

1608 Selection Rules for the Dematerialization of a Particle into Two Photons. C. N. Yang. Phys. Rev. 77, 242-5(1950) Jan. 15.

Selection rules governing the disintegration of a particle into two photons are derived from the general principle of

invariance under rotation and inversion. The polarization state of the photons is completely fixed by the selection rules for initial particles with spin less than 2. These results which are independent of any specific assumption about the interactions may possibly offer a method of deciding the symmetry nature of mesons which decay into two photons. (auth)

1609 Self-Energy of a Moving Charge. M. A. Markov. Zhur. Eksptl. i Teoret. Fiz. 18, 1130-3(1948)(in Russian).

The expressions that are usually given for the self-energy of a moving charge exhibit an explicit dependence on the velocity that stands in contradiction to the transformational properties of the magnitudes involved. It is shown that this fact is closely related to the presence in the said expressions of diverging integrals. By simple operations the usual expressions can be given a form that reflects the correct dependence on the velocity. (auth)

1610 The Use of Quaternions in Wave-Tensor Calculus. C. W. Kilmister. Proc. Roy. Soc. (London) 199 A, 517-32(1949) Dec. 7.

Quarternions are used to obtain some of Eddingtons's results in a general affine space (Relativity Theory of Protons and Electrons. Cambridge, England, Cambridge University Press, 1936; Fundamental Theory. Cambridge, England, Cambridge University Press, 1946.), and a more convenient notation for E-numbers is suggested. As an example, Dirac's equations are derived, their connection with the affine space of distant parallelism is explained, and Eddington's views on their 'Euclidean' nature are discussed. (auth)

1611 Wave-Mechanical Perturbation Calculation by Means of the Laplace Transform (with an Application to the Stark Effect). H. Kallmann and M. Päsler. Z. Physik 126, 734-48(1949)(in German). (See also NSA 2-1651.)

This paper is a continuation of a previous series of investigations concerning the solution of wave mechanical problems by means of Laplace transforms (Ann. Physik 2, 292(1948); 305(1948); ibid 4, 90(1948); 46(1948); ibid 3, 305(1948); and Physik. Blätter 5, 47(1949)). A perturbation method is developed which is applicable when the unperturbed wave equation after application of a Laplace transform reduces to a first order linear differential equation. The perturbation function is assumed to be a sum of terms proportional to a nonlinear power of the variables occurring in the original wave equation. The perturbed equation for the Laplace transform is then a differential equation of higher order than the first. After a general discussion of the solution of this equation, the method is applied to the theory of the Stark effect. By means of a theorem concerning the asymptotic behavior of Laplace transforms the Schwarzschild-Epstein formula is derived. Furthermore, a simple representation is given for the eigenfunctions of the Stark effect.

1612 Wave Mechanics of the Photon and Quantum Theory of Fields. Louis de Broglie. Paris, Gauthier-Villars. 1949. 208p.

This book is divided into three sections. The first applies the general principles of wave mechanics to a single particle, and in particular to a photon; the second extends the theory to many-particle systems, using with minor variations the usual methods of second quantization; the third deals with photons in interaction with matter. The main difference of the author's method from that of quantum field-theory is the following. Instead of beginning the theory with electromagnetic field-strengths as dynamical variables represented by operators, he uses as primitive idea the wave-function of a photon, which is a 16-component quantity transforming under Lorentz transformations like the product of two Dirac spinors. Field-strengths are introduced later, as matrix-element-densities which when integrated over space give matrix elements for the annihilation of photons in various states. Field-strengths are not Hermitian operators, the Hermitian field-strength of orthodox theory being essentially the sum of the author's field-strength and an adjoint operator which creates photons instead of annihilating them. In general the author's theory is only formally different from quantum field-theory, and leads to the same results in all specific applications. In particular, the divergence difficulties of electrodynamics are not alleviated.